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Rural Electricity Supply.

ELSEWHERE in this issue we give an account of the official inauguration of an extremely interesting scheme for electricity supply in rural areas, which is notable in several respects.

In the first place, the Northwich Electric Supply Company was the first to use a bulk supply of gas (Mond gas) for the generation of electricity for public service; we published a full description of the plant in our issue of February 1st, 1901. Since then little progress has been made in this direction in practice, though the subject of co-operation between gas and electricity supply undertakings has been frequently discussed during recent years, and is in fact now being examined by a joint committee of the Institution of Electrical Engineers and the Institution of Gas Engineers, whilst it will come under the consideration of the National Fuel and Power Committee which the Government has just set up in accordance with a recommendation of the Coal Commission. Incidentally, it is appropriate that the chairman of this Committee should be Sir Alfred Mond, a director of Messrs. Brunner, Mond & Co., who supply the Northwich company with Mond gas.

The Northwich Co., unfortunately, was not a paying concern for many years, but it grimly persevered in the face of many difficulties, and now appears to be in a very strong position—thanks largely to the undaunted efforts of its electrical engineer, Mr. W. Fennell, M.I.E.E., whose robust faith in the sound prospects before rural electricity supply, and vigorous agitation for relief from the irksome restrictions which retard its progress, have been amply exemplified in our columns from time to time. Due credit must also be accorded to the enterprising and far-seeing board of directors, whose support was essential to the fruition of Mr. Fennell's plans.

It will be noticed that the Mid-Cheshire Electricity Supply Company, into which the original concern has developed since its area was extended, now derives a

supply of electricity in bulk from the Mersey Power Company's generating station at Runcorn by way of the mains of the North Wales Power Company. This station, though then having a maximum demand of only 9,100 kW, in 1924-5 had the lowest average fuel consumption per kWh generated and the highest thermal efficiency in Group D of the Electricity Commissioners' returns, and is being linked up with the North Wales Power Company's system, which is dependent upon water-power for its electricity supply—an admirable combination. The distance of transmission is quite short, being only six miles from Runcorn and five miles from Crewe.

The supply is given in Mid-Cheshire by 33,000-V overhead mains and sub-stations with outdoor transformers and h.p. switchgear, on the most economical lines, and rural distribution is effected largely with overhead mains at 6,600 and 3,300 V, transformed down for local urban supply by underground mains at 380/220 volts. The total cost of a village sub-station for the latter purpose is said to be no more than £250. It is interesting to learn that Mr. Fennell has also reduced the cost of tapping the 33,000-V lines to £75, excluding the cost of transformers.

It was stated at the opening festivities that the undertaking was on the lines of the Government's scheme for the national supply of electricity. With this view we cannot agree, though we welcome the Mid-Cheshire scheme as being closely in accordance with the system that we should like to see more widely adopted. On the one hand, we have a large company entrusted with the electrical development of the whole of an Electricity District; on the other, a company entrusted with the development of a smaller area, within which it distributes electricity received in bulk from the larger concern, on highly economical lines. These two authorities deal directly with one another, and are free to manage their own affairs on the most advantageous plans, neither seeking nor receiving assistance or interference from the State. But the Government scheme contemplates the establishment of a purchasing authority to come between these two classes of undertakings, and to glean from the sale to one of the electricity generated by the other sufficient profit to enable it to pay the capital charges on 33½ millions sterling, borrowed in the first instance under a State guarantee. How can the Mid-Cheshire scheme be alleged to come under the Government scheme? On the contrary, it has gone far ahead of the latter, which up to the present has only caused a delay of 18 months (with more to follow) and disturbance throughout the electrical industries.

Special attention should be directed to the provision for rural electricity supply which is an essential part of the Mid-Cheshire scheme. Not only the villages, but also the farm-houses in the area, which is largely agricultural in character, are to be given a supply of electricity, and to promote the use of electric power on the farms, the company proposes to adopt a hiring system in respect of the heavier apparatus. The progress of this enterprising undertaking will be worth watching.

The New Factories Bill.

THE text has been published of the Factories (No. 2) Bill, which has been introduced by the Government to effect such changes in the existing law as have been shown to be desirable since the original Act was passed in 1901. The Bill first of all abolishes the distinctions existing between workshops and factories and between textile and non-textile factories, and except where it is specifically stated otherwise, the provisions of the Bill apply to factories of all descriptions. The abolition of the first distinction takes the supervision of the former "workshops" from the local sanitary authorities and places it with the factory inspectors, except in places where no mechanical power is employed, and which form part of a dwelling-house or shop in the same occupation.

With regard to the various clauses, there are many important alterations, one of which deals with the cubic space to be allowed to each person in factories. The allowance is to be raised from 250 cu. ft. to 400 cu. ft. for premises which come into use after the passing of the Act. It is as well to remember that this allowance may be increased by special order for, *inter alia*, any period during which artificial light other than electric light is employed.

The new Bill incorporates a number of Welfare Orders which have been issued since the passing of the original Act, and the clause relating to hoists and lifts is considerably extended.

Evidently the Government anticipates a great deal of discussion and criticism of the Bill, for it is stated that the text has been issued early to enable those concerned to examine the new proposals thoroughly before the Bill is proceeded with in the next session of Parliament. It is proposed that the provisions shall come into force as from January 1st, 1927.

The Government considers that the Bill, if passed, will raise the general standard of the conditions to the level which has been reached in the case of the more efficient and better-managed factories without placing any undue burden upon industry. The effect, it is believed, will be to promote the efficiency of industry as well as the welfare of the workers.

The B.E.S.A. Glossary.

THE furious onslaught made by Professor G. W. O. Howe on the "B.E.S.A. Glossary" at the B.A. meeting, which was powerfully supported by other distinguished teachers of electrical theory, was clearly an unwelcome surprise to the Editing Committee of the British Engineering Standards Association. As Prof. Howe remarked, he felt very hot at the time of writing the paper, which bears internal evidence to that effect; but Dr. W. Cramp, who contributes an article on the subject to our pages to-day, was prepared to quote many additional definitions which in his view were "hopelessly wrong," and it is evident that there is a wide divergence of opinion between the compilers of the Glossary and their critics. This is a very unfortunate state of things, for the definitions in question relate to the very foundations of electrical and magnetic theory. The situation is all the more difficult in that the matters in dispute are based not on physical entities, but on mental conceptions, which cannot be weighed or measured; they are, in fact, conventions, the essence of which is agreement, and if agreement is lacking they crumble to pieces.

We should be very loath to express an opinion with regard to the merits of the controversy; it is a matter which must be settled by those whose business it is to use such terms and definitions in the course of their professional duties; but we are disposed to agree with some of the speakers in the discussion that it is a pity the definitions were not circulated amongst the leading teachers of electrical engineering for consideration before they were put into print. It is, of course, easy to say so after the event; but in view of the very emphatic declarations of the Editing Committee, in the circular accompanying the copies issued for review (which were quoted by Professor Howe), to the effect that "the necessity for making efforts to secure that the meanings of the terms used are, as far as possible, permanently retained is urgent." it would seem that every possible precaution should have been taken to eliminate all material for controversy.

Obviously the matter, which is of fundamental importance, cannot be left where it is, and we trust that the conference of committees suggested by Sir John Snell will be brought together, to enable the questions at issue to be finally and permanently settled.

Electricity Supply in London.—I.

Some Switching Details of an Important Interlinkage Scheme.

In view of the widespread attention which the reorganisation of the electricity supply industry is receiving at present, the fact that a considerable amount of interlinkage work has already been carried out unobtrusively in the London area is of sufficient interest to have prompted the preparation of the following notes with reference to two important electricity supply groups to show, in the first instance, how switchgear has been arranged to enable the companies concerned mutually to assist one another and ensure continuity of supply.

For the ensuing information relative to this extensive scheme we are indebted to the British Thomson-Houston Co., Ltd., contractors for the whole of the switchgear, protective apparatus, &c., as well as to Messrs. Kennedy and Donkin (consulting engineers), Sir A. B. W. Kennedy, F.R.S. (engineer-in-chief), and Mr. H. P. Gaze, M.Inst.C.E., M.I.E.E. (executive engineer) of the Central Company; and to Major H. Richardson, M.C., M.I.E.E., chief engineer of the Metropolitan Company.

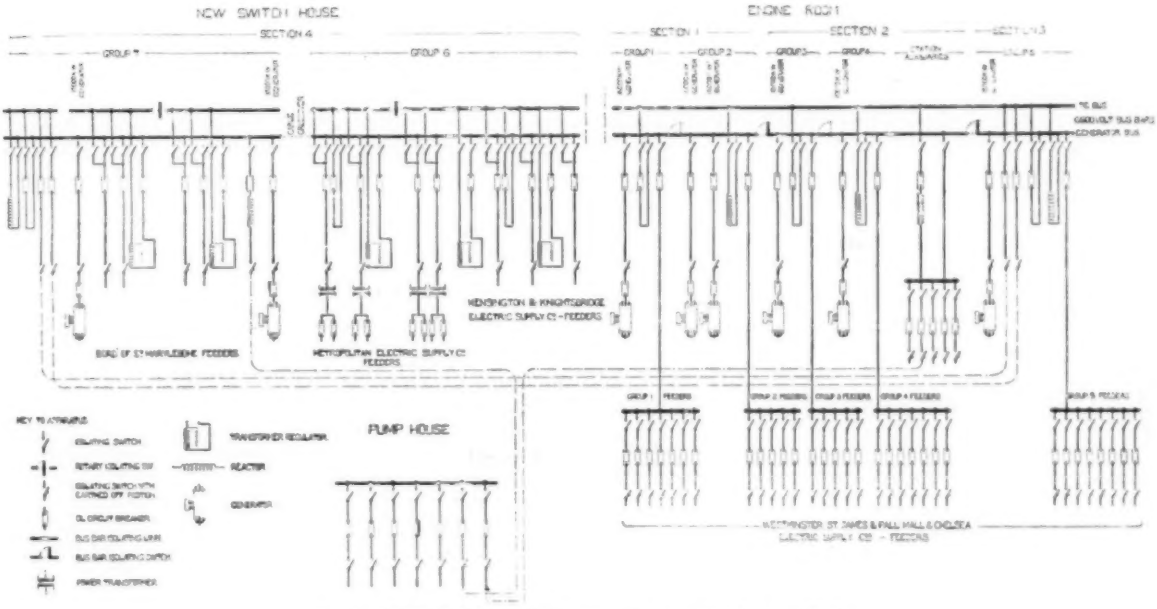


Fig. 1.—E.H.P. Switchgear Arrangement at Grove Road Power Station.

Central Electric Supply Co.

The Grove Road power station originally supplied power in bulk to the Westminster Electric Supply Corporation, Ltd., and the St. James' and Pall Mall Electric Light Co., Ltd. In 1924, however, arrangements were made for the supply of power in bulk to the Kensington and Knightsbridge Electric Lighting Co., Ltd., and for interconnection with the Metropolitan Electric Supply Co.'s Amberley Road station; in 1925 arrangements were also made to interconnect with the St. Marylebone Borough Council's undertaking.*

Power is generated at 6,600 volts, 3-phase, 50 cycles, and the generating plant and feeders will ultimately be divided into four sections, which are again sub-divided into groups, each containing a set of generator bus-bars and a set of feeder bus-bars, in addition to tie bus-bars extending throughout the whole gear, to which any of the generator bus-bars can be coupled through current-limiting reactors. It is also possible to couple the generator bars of any section directly on to the tie bus-bars without reactors in the event of the generating plant in that particular section being shut down. Each set of feeder-group bus-bars is also connected to its respective generator-group bus-bars through an automatic oil circuit breaker. The general arrangement of the whole scheme is shown by fig. 1.

For interconnection with other supply authorities' systems the feeder bus-bars are connected to the generator bus-bars through induction-type regulating transformers, so that the amount and direction of load transferred can be controlled.

Formerly the station's auxiliary power was taken from separate bus-bars coupled by means of a single automatic circuit breaker to the main tie bus-bars, but an alternative supply is now provided from the feeder-group bus-bars which serve the St. Marylebone Council, and a complete new bank of switchgear has been erected to control the pump-house auxiliaries, with interlocks to prevent the equipment being fed from both sources at the same time.

Messrs. Callender's Cable & Construction Co., Ltd., supplied the cables for interlinking the Central Co.'s Grove Road power station with the Metropolitan Co.'s Harlesden power house and its Amberley Road sub-station.

In the new switch-house the cells are of a double-structure pattern, with a gallery on a level with the bus-bar selector and isolating links, for ease in operation (fig. 2). All switchgear is of the cellular type, and phase separation has been adopted throughout, each piece of apparatus being mounted in a separate compiece of apparatus being in a separate compartment.

The group-feeder and bus-bar-coupler oil circuit breakers, together with those mounted on the foundations of each of the larger generators, are of the British Thomson-Houston Co.'s "H" type, the initial movement of the stroke being caused by springs and the travel completed by a motor which also winds up the springs ready for the next stroke; the springs alone suffice to cause a breaker to make and break contact satisfactorily, and tripping in an emergency is not dependent on the d.c. supply to the operating motor.

In the new switch-house the oil circuit breakers are of the B.T.-H. Company's OM 302-H1 type, each consisting of three single-pole units mechanically coupled to a shaft which is operated by solenoid mechanism. Each single-pole unit, as illustrated in fig. 3, is fitted with a pebble-filled separation chamber and vent pipe

*See ELECTRICAL REVIEW, December 4th, 1925.

so arranged that conducting gases are released outside the cubicle: the contacts are of the explosion-pot type.

Selector and isolating switches are of the standard pole-operated pattern, with safety catches to prevent their operation by the forces which arise under heavy-current conditions. The Metropolitan Company's and

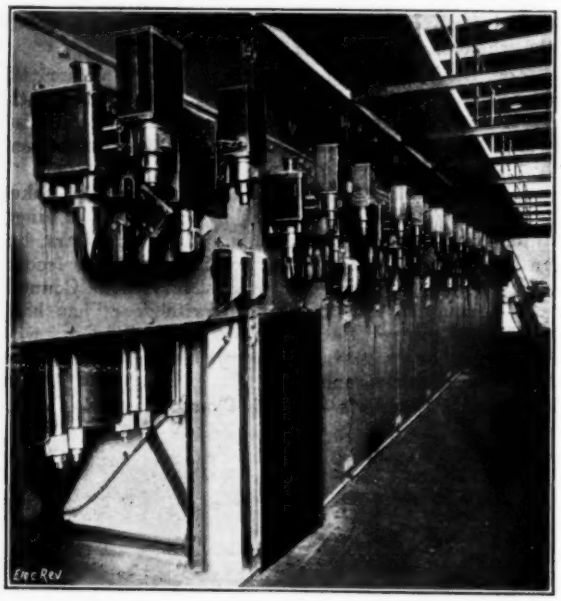


Fig. 2.—New Switch House at Grove Road Station, showing 6,600-V Breakers, Operating Mechanism, and Bus-Bar Gallery above.

St. Marylebone Council's feeder bus-bars, which will ultimately be fed through two induction voltage regulators each and supply four interconnector feeders, are provided with rotary isolating links so that they may be sectionalised each into two portions, comprising one induction voltage regulator and two interconnector feeders. The rotary isolating links are fixed directly in the run of the bus-bars and are operated as single-pole units by an insulated turn key.

Instrument transformers in the new switch-house are all of the bar-primary pattern. Where the value of the short-circuit kVA is limited as in the case of some of the groups in the original switchgear installation) and accurate metering of small currents is required, wound-primary transformers are provided. The insulation between the primary and secondary windings of all transformers of ratios of 800 amperes and below, consists of porcelain; above this ratio the insulation consists of rolled varnish-treated paper tubes, which have a corona sheath inserted under the internal surface with a lead for connecting the sheath to the primary conductor, so that there is no possibility of corona discharge between the inside of the tube and the primary conductors. All potential transformers are oil-immersed and, where possible, the single-phase type has been employed, so that complete phase separation can be maintained. Provision for isolating the potential transformers has been made, and they are protected by fuses mounted on the terminals, the fault current to be dealt with by the fuses being limited by resistances connected in series with them.

The protective gear for the generators is of the standard circulating-current type with field-suppression switches; the arrangements are, however, rather different from those usually adopted: each generator is provided with an "H" oil circuit breaker, as mentioned above, built into cellwork (fig. 4) which forms an integral part of the foundations of the machine. Being automatic in action, the breaker is always used when the generator is automatically disconnected from the bus-bars, thus protecting the leads between the generator and the main switchboard, which in this particular station are probably longer than usual. In addition to this "master switch," a further oil circuit breaker is provided in the main circuit (arranged in the usual way on the main bank of switchgear) for synchronising purposes only; its rupturing capacity is sufficient to deal with any short circuits which may occur on the system.

The feeder protective gear between the Grove Road station and the Westminster Electric Corporation's sub-stations is of the B.T.-H. opposed-e.m.f. pattern in some cases, and in others balanced-current and power protection for duplicate parallel feeders is employed. Both these schemes embody biasing transformers, although the principle of their operation is similar to those of the standard Merz-Price and balanced-feeder systems.

In the case of the interconnections between Grove Road and the Metropolitan Co. the pressure on the cables is 22,000 volts, and the step-up transformers are protected by circulating-current arrangements, with the addition of B.T.-H. biasing transformers. Two of the

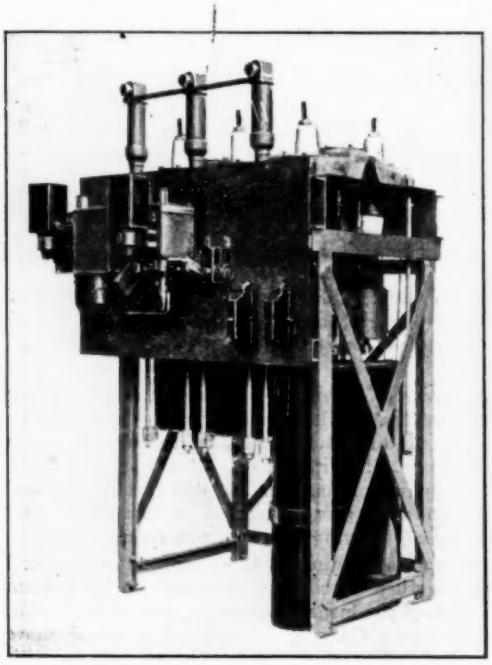


Fig. 3.—Type 302-H1 Single-Pole Oil Circuit Breaker.

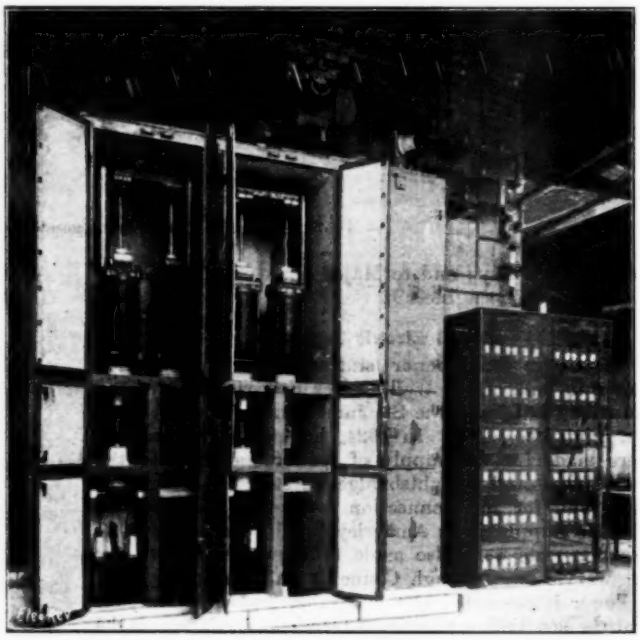


Fig. 4.—Type H 6,600-V Breaker mounted on Generator Foundation, Grove Rd. Station.

Metropolitan Co.'s feeders are so equipped and, with their transformers, form a straight-through link to the Amberley Road sub-station; ultimately, however, the high-voltage side will double feed the Amberley Road and Eagle Street sub-stations, and as no 22,000-volt oil circuit breakers have been installed, but merely oil-immersed links for isolating the feeders, special protective arrangements have been made as follows:—

The feeders are protected on the B.T.-H. opposed-e.m.f. system, and the branch from Grove Road to Amberley Road is protected separately from a branch from Grove Road to Eagle Street; the transformers are provided with circulating-current protective gear. If a fault should occur in a transformer, the oil circuit breakers at Amberley Road, Eagle Street, and Grove Road would be tripped; if a fault should occur in the Grove Road-Amberley Road section, the 6,600-volt breaker at Grove Road would trip, together with those at Eagle Street and Amberley Road; if a fault should occur in the Grove Road-Eagle Street section, the 6,600-volt breaker at Grove Road would trip, together with the breakers at the other ends of the Amberley Road and Eagle Street feeders.

The transformer and feeders to Amberley Road and Eagle Street form one circuit, and in the case of a fault on any part of this circuit the 22,000-volt oil circuit breakers at those sub-stations, as well as the 6,000-volt breaker at Grove Road, would all be tripped. Relays are fitted to the control board to indicate whether a fault is to earth or between phases, and on which section of the feeder or transformer it is situated. The two feeders supplying the new pump-house are protected on the circulating-current system, as they are comparatively short.

Reactors are used between the various generator-group bus-bars and main bus-bars, and will probably be used also in the station auxiliary section of the switchgear

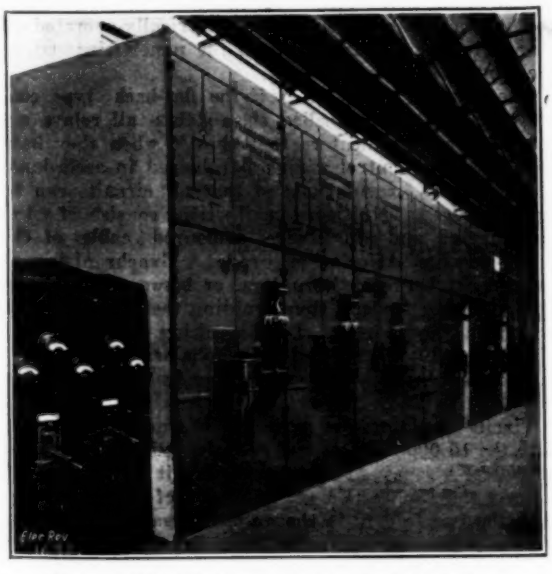


Fig 6.—E.H.P. Switchboard, Amberley Road Sub-Station.

on the original switchboard. They are of the air-cooled, cast-in-concrete pattern, characterised by the absence of any organic material in their construction and by exceedingly liberal spacing between the bare conductors, which are embedded in specially-treated concrete coil supports, each layer taking the form of a truncated cone, alternatively upright and inverted. Where the layers converge towards a point, the voltage between them is a minimum, and maximum spacing occurs with a maximum voltage difference. The end layers are more liberally spaced to allow for the voltage rise on the end turns under short-circuit conditions.

The polished white marble main control board contains all the apparatus necessary for controlling the generators, bus-bar couplers, and group feeders on the old switchboard and, in the case of the switches in the new annexe, the gear is mounted on a gallery which runs the whole length of the engine room, from which it is separated by a glass partition. A bench-type switchboard has been installed for the control of

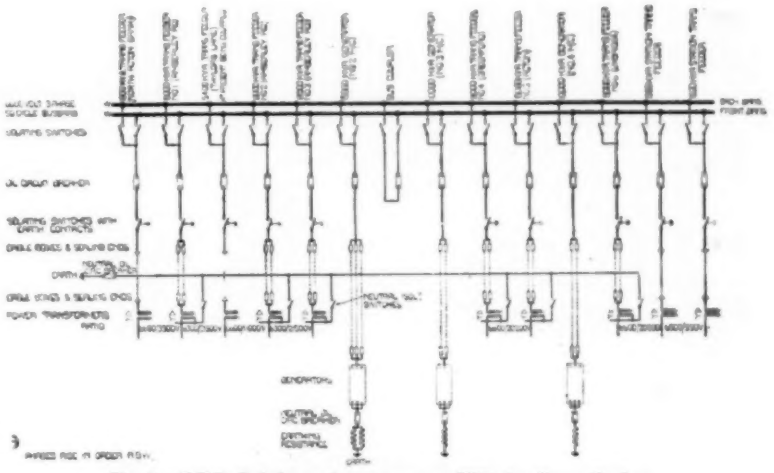


Fig. 5.—E.H.P. Switchgear Arrangement at Willesden Power Station.

generator-field circuits and also to accommodate the voltage regulators. The control wiring throughout the new annexe consists of v.i.r. multicore cable, lead covered and wire armoured.

The new bank of switchgear for the control of auxiliary pumps, &c., is of the cellular pattern, and the B.T.-H. oil circuit breakers are of type OM110 A1, the three single poles being coupled together to one operating mechanism.

Metropolitan Electric Supply Co.

In the Willesden power station switchgear is installed at present for the control of two 10,000-kW and one 15,000-kW sets generating power at 6,600 volts, 3-phase, 50 cycles. The 6,600-volt cubicles are provided with duplicate bus-bars, a coupler allowing for the rapid transfer of circuits from one set to the other under load. Generator and feeder circuits are each provided with one oil circuit breaker, arranged for connection to either set of bus-bars through selector switches, cable isolators with earthing contacts having been supplied in addition for all feeders. Power for the station auxiliaries is obtained from two 1,500-kVA, 6,600/415-volt transformers.

The accompanying single-line diagram (fig. 5) shows the main connections for the 6,600-volt switchgear, six 8,100-kVA feeders being at present installed.

Each 22-kV feeder is connected directly to an 8,100-kVA transformer bank, switching being carried out at the ends remote from the Metropolitan Co.'s Willesden power station, with which the Grove Road power station of the Central Co. is interconnected, *via* Amberley Road, by means of three 22-kV 0.25 sq. in. parallel feeders.

A spare 6,600-volt cubicle is being equipped to control a feeder between the Willesden power station and the North Metropolitan Co.'s Taylor's Lane power station, for which three single-phase, 6,600/11,000-volt transformers having a total capacity of 5,400 kVA are being installed at the Willesden end of the feeder.

The 6,600-volt switchgear is of the cellular type, with phase separation throughout, and the control panels are mounted on a gallery which is continuous with that round the cubicles and from which the bus-bar selector switches are operated; a portion of it is provided with

glass treads to assist in lighting the circuit breaker and instrument transformer compartments, which are accessible from the cubicle foundation level.

The oil circuit breakers are of the OM302 H1 type and electrically operated from a 110-volt battery. The bus-bar selector and cable-isolating switches are of the standard single-pole, single-throw, pole-operated pattern, and the current transformers for the 10,000-kVA and the 15,000-kVA generator cubicles are of the single-turn primary pattern, with treated-paper insulating tubes through which the cubicle connections are taken to form the primary conductor; two transformers for

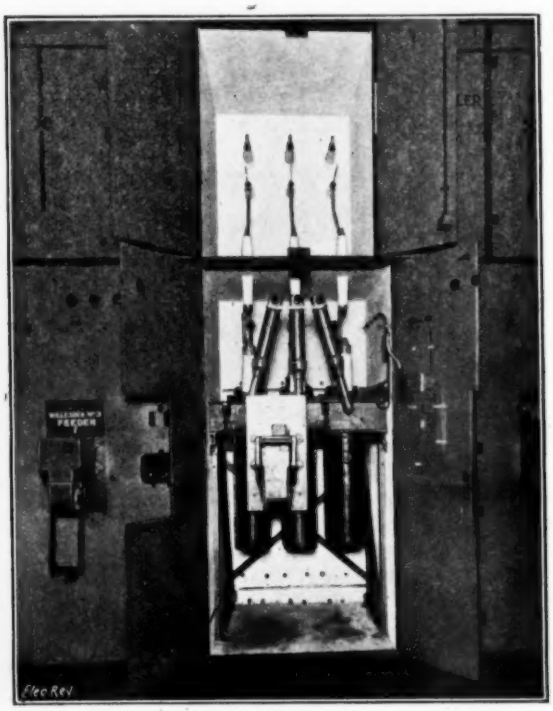


Fig. 7.—Amberley Road Sub-Station Cubicle showing 22,000-V Breaker, Control Wiring, etc.

each phase are mounted on a common insulating tube, one being used for the operation of instruments and stand-by overload relays, and the other for the circulating-current protective gear. Three similar transformers are provided for each alternator neutral in connection with protection, and others for the Tirrill voltage regulators, one transformer being used for compounding for line drop and the other to impart stability in the case of parallel operation.

Bar-primary current transformers are provided for all of the feeder circuits, and the potential transformers are single-phase and oil-immersed, with cartridge-type primary fuses secured by clips mounted on the leading-out insulators; the transformer body is secured to the cover so that it can be removed from the tank without disturbing the connections and without injury to the windings. Limiting resistances are connected on the primary side, each of which is mounted on a wheeled truck and has a metal guard attached to the cover so as to prevent the possibility of accidental contact with live metal whilst in position in the cells; this arrangement allows for rapid inspection and permits the quick replacement of blown fuses, or even of a transformer, without interruption of the main circuit.

Each alternator neutral is earthed through a separate metallic resistance, an electrically-operated oil circuit breaker also being connected between each alternator neutral and the earthing resistance. Standard circulating-current protective gear, including a field-suppression pedestal, is installed. The relay is arranged to trip the main and neutral breakers and the field-suppression switch, and the machines are also provided with stand-by overload and leakage protection by means of induction pattern definite minimum inverse time-limit overload relays. The two overload relays are operated from the instrument current transformers, but the leakage relay is operated from a separate current transformer mounted in the alternator neutral.

The 8,100-kVA transformer banks are provided with circulating-current protective gear employing a B.T.-H. biasing transformer, the use of which ensures a high "stability ratio" in the case of through short circuits, and obviates the necessity of attempting to balance protective transformers on the primary and secondary sides of the transformer bank, which usually have inherently different characteristics; it also permits of the use of a simple type of electro-magnetic relay and prevents it being subjected to excessive operating forces in the case of faults of short-circuit magnitude. A feature is the d.c. transient bias, which is introduced while switching in the transformer bank to prevent the possibility of inadvertent operation of the protective relay due to the magnetising current rush. The d.c. winding of the biasing transformer is energised through the agency of contacts provided on the oil circuit-breaker control switch, so that the d.c. bias is removed when the control switch returns to the "off" position.

The circulating-current protective transformers on the 22-kV side of the transformer banks each consist of a core and secondary coil mounted in a metal-clad, compound-filled case and arranged to slip over the p.i.l.c. tails between the 22-kV trifurcating box and the power transformer terminals.

The three parallel 22-kV feeders to Amberley Road are protected by opposed e.m.f. gear, and a biasing transformer is employed, thus obviating the necessity of using special sheaths in connection with the pilot cables.

Since no switching is carried out on the 22-kV system at the Willesden power station, in the event of a fault on a 100-kVA transformer bank, or the associated 22-kV feeder, the transformer circulating current and the opposed e.m.f. feeder-protective gear is arranged to trip the 22-kV breaker at Amberley Road as well as the 6,600-V circuit breaker at the Willesden power station.

Similar protective gear is provided on the other transformer banks for feeders supplying the Western area.

The neutrals on the 22-kV side of the 8,100-kVA transformer banks are each connected to a common earth bar through a single-pole, pole-operated isolating switch, the earth bar being connected direct to the main station earth by means of a single-pole, electrically-operated oil circuit breaker controlled from the panels situated on the control gallery.

The control panels are of the flat-back type constructed of black-enamelled slate slabs; all relays are provided with indicators to "show" when they have operated, and control wiring is coloured in accordance with B.E.S.A. regulations so that all circuits can be readily traced. Multicore small wiring consists of v.i.r. lead-covered and single-wire armoured cable of the 2,500-megohm Association grade. Synchronising is carried out between alternators, or between alternators and incoming feeders, thus avoiding the use of bus-bar potential transformers. Loud-speaking telephones and Chadburn illuminated-dial telegraphs are used for communication between the control panels and the boiler house.

Tirrill regulators are provided, one normally for use with the 15,000-kVA set and the other with either of the 10,000-kVA sets. At certain periods it is necessary to connect the 15,000-kVA set to one set of bus-bars along with the two feeders to the western area, the regulator being set to compound for line drop. Change-over switches enable either of the two regulators to be connected to any one of the three alternators, being so arranged that it is not possible to parallel two exciters. One current coil is provided in each regulator to be used either to give stability on parallel running, or to compound for line drop.

The Amberley Road sub-station has been rearranged to take a supply at 22,000 volts, 3-phase, 50 cycles, from the Grove Road and Willesden power stations, this pressure being transformed down and modified for distribution.

The installation of the 22,000-volt equipment had to be undertaken by stages, as only after the first feeders and transformer controls were in place was it possible to remove existing gear to make space for further units. The very limited space available also influenced the design of the 22,000-volt switchgear, which is both simple and compact (figs. 6 and 7).

The oil circuit breakers in this sub-station are of the B.T.-H. type OM.201-H1, and the isolating switches are of the standard pole-operated pattern. Arrangements have been made at two points in the length of the bus-bars to measure the supply taken by the transformer circuits. Current transformers of the oil-cooled type are used, and six isolating switches are provided to cut these transformers out of circuit, but in order to avoid any interruption of supply, three additional isolating switches are used to short circuit the current transformers in the first instance. The potential transformer is three-phase, and also oil cooled, and it can be separately isolated and removed for examination.

The metering equipments are placed so that supply can be fed through either one to the transformer equipments and taken from Grove Road or Harlesden, or from both simultaneously.

The oil circuit breaker of each transformer equipment controls two banks of Scott-connected transformers giving 1,000 volts, two single phases split for three wire. The circuit is divided after leaving the 3-phase breaker, and six isolating switches are provided so that any one bank of Scott-connected transformers can be supplied at a time, while the leads to the other bank can be earthed. Protection is given to the 22,000-volt transformer windings by bushing transformers operating fixed minimum and inverse time-limit overload relays and instantaneous earth relays. The l.p. windings have special circulating-current protection with instantaneous relays combined with inverse time-limit overload fuses, thus avoiding the use of current transformers in the 22,000-volt leads to the main transformers, apart from the bushing transformers on the oil circuit breaker. The feeders are protected on the opposed e.m.f. system.

Electric Steam Generation.

Details of Modern Electric Boiler Equipment.

By C. H. TUPHOLME.

(*Concluded from page 293.*)

It is also possible to construct the accumulator as a high-pressure steam boiler and to draw off steam from it for heating or for manufacturing purposes. For example, the boiler can be heated up at a cheap rate during the night to a pressure of about 170 lb. per sq. in. (12 atm.) and then steam can be drawn off from it during the day, although, of course, at a continually decreasing pressure. For manufacturing purposes steam can generally be usefully employed so long as the working pressure does not fall below 28 lb. per sq. in.; in other cases it can be used as low as atmospheric pressure. The boiler must therefore be so designed that when it is at full pressure in the morning it can work till the evening without the pressure falling lower than desired. To form an approximate estimate of the size of boiler required, it may be assumed that about 6 to 7½ lb. of steam can be stored per cubic foot of hot water (100 to 120 kg. per cubic metre) at the usual pressures. One kWh gives about 2.7 lb. (1.25 kg.) steam. If, then, in a fairly small plant, there is about 80 kW available for 10 hours during the night, the accumulator must be capable of storing 800 kWh, or, in round figures, 2,200 lb. (1,000 kg.) of steam, *i.e.*, it must have a capacity of about 350 cu. ft. (10 cu. m.).

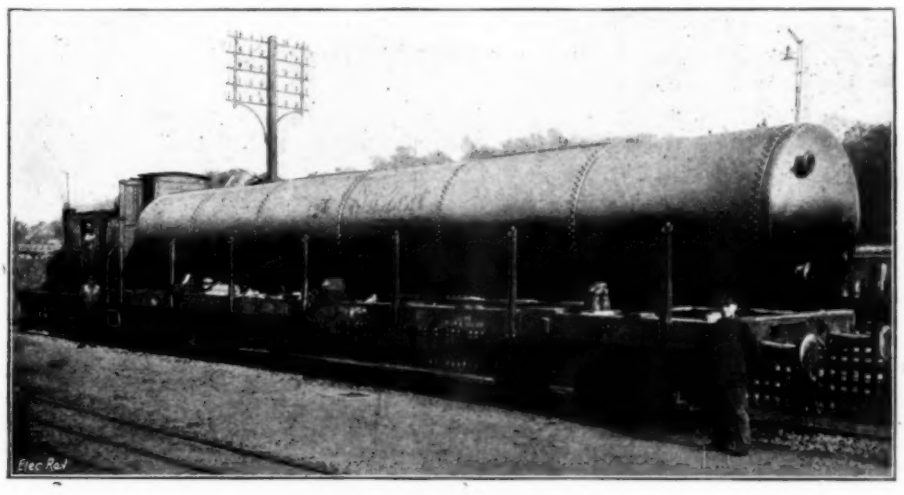


Fig. 7.—Large Electric Heat-Storage Boiler.

Under certain conditions electric heating is cheaper than heating by coal. This is the case in places where the cost of electricity is low, and especially where there is a great demand for it and it is possible to make use of surplus electrical energy in very large quantities during the night and in the summer, and would apply to factories where steam is required at seasons when a large amount of water-power is available, and the power stations are only too glad to find a means of using the electrical energy generated. But even when electric heating is dearer than heating by coal, it has often many advantages which make it desirable and more convenient.

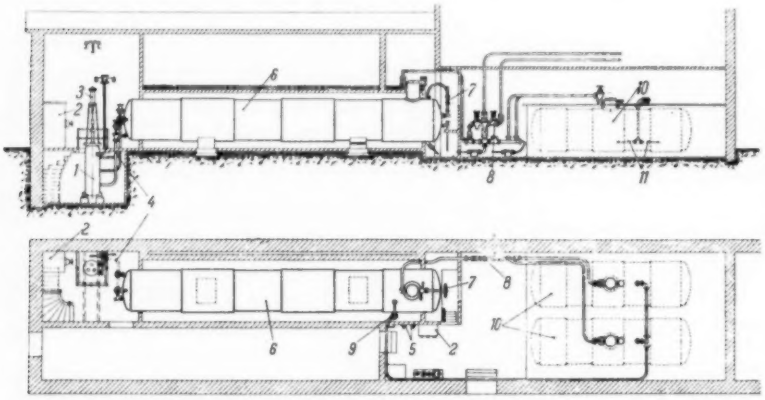
The simplicity of the electrical plant facilitates attendance, and its cleanliness is also often a recommendation. Besides that, there is no trouble in transporting and storing sufficient stocks of fuel, and there are no ashes to be got rid of.

The extra cost of electric heating, if it be dearer, is also not so great as is generally assumed, as the efficiency of an electric plant with properly installed apparatus is much higher than when coal is used. To get some idea of the cost of working an installation, it may be assumed that the following quantities of electricity are required in order to give the same heating effect as 1 kg. (2.2 lb.) of average quality coal:—

In small boilers	3 kWh
In larger central-heating installations and similar plant	4 kWh
In large heating plants for industrial purposes and in high-pressure steam boilers	5 kWh

A boiler of the last-mentioned type is one which has been installed in the spinning mills of Messrs. Spœrri & Co. at Flums, Switzerland (fig. 7); it is 51.8 ft. long by 6.6 ft. in diameter, and capable of storing sufficient energy to give 9,900 lb. of steam.

Messrs. Spœrri & Co. have water power available which is utilised in two stages, and, in addition, a large pond holds sufficient water in storage to supply the firm with hydraulic power for one week. The electrical energy generated is utilised in the spinning mills, the Flums carbide works, and for other lighting and power purposes. After leaving the lower power station, the water is used for driving some small works down stream in the village of Flums. Since, however, the working hours there do not correspond with those of the mills, especially in the early morning, it is necessary to allow water to flow unused from the weir before starting up the mills, in order to supply power to the hydraulic works further down the stream.



1, electric boiler; 2, switchboard; 3, hydraulic servo motor for regulating output; 4, feedwater piping with hydraulic stop valves; 5, cocks for regulating the output and closing members; 6, storage boiler; 7, pressure gauge; 8, control station and steam distribution; 9, automatic by-pass valve; 10, coal-fired boilers; 11, steam injection nozzles.

Fig. 8.—Industrial Electric Heat Storage Plant.

Obviously, this water is completely lost as far as power purposes up-stream are concerned, a disadvantage which is not felt in the summer time when there is generally an ample supply of water overflowing the weir. In winter time, however, it is necessary to utilise all the hydraulic energy possible, and in order to effect this, Messrs. Spœrri have installed an electric heat-storage boiler plant in which steam is raised for heating all the spinning mills. This steam is used in the early morning for heating up, and passes through the heating piping at a pressure of from 40 to 55 lb. per sq. in. Towards evening the pressure may fall to between 15 and 30 lb. per sq. in., and in this manner the storage capacity of the boiler is fully utilised.

The working conditions which the plant has to fulfil are as follows:—

Maximum load about 700 kW.
Normal load about 500 kW.
Minimum load about 100 kW.
The current used is three-phase, 5,000 volts, 50 periods.
Maximum working pressure of storage boilers, 170 lb. per sq. in.
Maximum water capacity, 10,000 gals.
Storage capacity when discharging at a pressure of 28 lb. per sq. in., 10,000 lb. of steam.
Working pressure of coal-fired boilers, 100 lb. per sq. in.
Storage capacity when discharging at a pressure of 28 lb. per sq. in., 3,500 lb. of steam.
Total storage capacity of boilers, about 13,500 lb.

The maximum load on the electric boiler has been highly rated owing to the comparatively short time during which it is electrically served.

An automatic by-pass valve is fitted between the storage boiler and the coal-fired boilers, and allows steam to pass from the former to the latter before the safety valve of the storage boiler comes into operation. The controlling apparatus is placed between the storage boiler and the coal-fired boilers. This consists of:—A switchboard with the necessary voltmeters, ammeters, signal lamps, &c.; servomotor control valves for the hydraulic regulator for controlling the current supplied to the electric boiler; control valves for the automatic stop valves in the piping between the electric boiler proper and the storage boiler; boiler feed pump, and the steam pressure reducing and distributing valves. In order to utilise the heat which radiates from the storage boiler, a room for drying purposes is provided above the brick work.

The complete plant, which is shown in fig. 8, was designed and installed by Sulzer Brothers, Winterthur, the electric equipment being manufactured by Messrs. Brown, Boveri & Co., Baden, Switzerland. The results obtained are fully up to expectation, and the plant is giving every satisfaction in service.

Fig. 9 shows a Sulzer electric boiler installed in a paper mill. It has a working pressure of 150 lb. per sq. in., and is supplied with electrical energy at 10,000 V, 3-phase; its loading is 3,500 kW. It is provided with automatic regulation of water level.

An electric steam generator which is finding extensive use in the United States where cheap energy is available, is that manufactured by the General Electric Company, Schenectady. This boiler consists of four essential parts (see fig. 10):—

(1) The steel shell with suitable compartments containing water and steam.

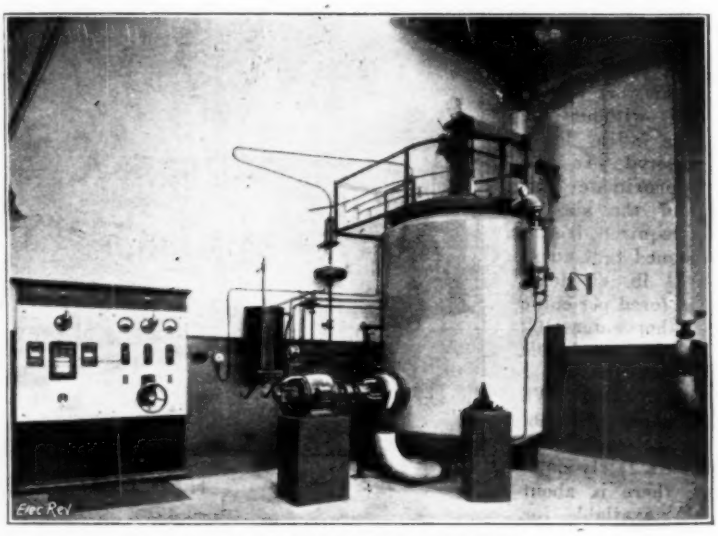


Fig. 9.—3,500-kW Electric Storage Boiler.

(2) The electrodes and leads for bringing the electric circuit into contact with the water.
(3) Motor-driven pump and control equipment for circulating the water.
(4) Primary control panel.

The thickness of the steel shell is determined by the steam pressure, and the standard accessories fitted include sight gauges and water columns for indicating the water level in the two compartments of the shell, the steam pressure gauge, and safety valves. The water

level in the lower or storage compartment is maintained by an automatic boiler-feed-water regulator, but boiler feed pumps are not included as part of the standard equipment, it being assumed that the feed water will be delivered at a pressure above the steam pressure.

The form of the electrodes depends largely on the voltage and capacity of the generator, but in general

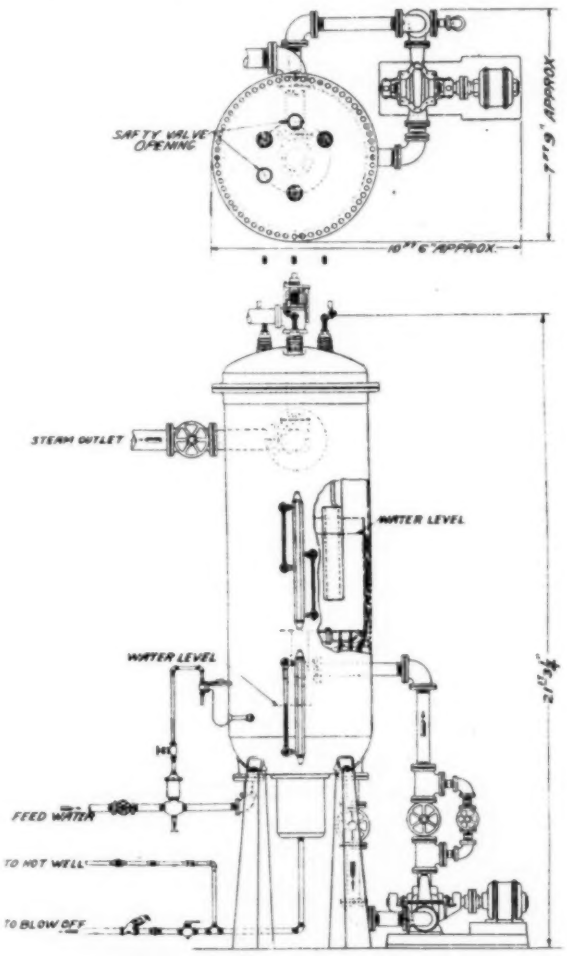


Fig. 10.—Typical American Steam Generator.

the electrodes consist of vertical plates extending downward into the water, and concentric with the walls of a so-called basket. The current flows between the electrodes and also from them to the basket, which forms an earthed neutral since it is supported from, and mechanically connected to, the shell. Current is brought to the electrodes by copper leads which extend through insulating bushings in the generator head. These bushings are specially designed to withstand the applied voltage as well as to remain steam-tight under pressure.

All the heat is liberated in the body of water contained in the electrode chamber, and since the steam must be released at the surface, provision is made to circulate the water continuously at a rapid rate past the electrodes in order to prevent the formation of steam bubbles and the tendency to prime. The water flows by gravity from the lower or storage chamber to the circulating pump, and is delivered by it to the upper or electrode chamber in such a way that it passes upward past the electrode surfaces, and is drained back to the storage chamber through openings in the walls of the basket. A throttle valve in the pipe line from the pump permits regulation of the rate of flow, and, therefore, of the water level in the electrode chamber, since the rate of drainage is practically constant. The height of water in the electrode chamber in turn determines the resistance of the electrical circuit, and thus provides a simple means of regulating, by hand or automatically, the electrical input, and consequently the steam output.

By means of a throttling device the pressure can be held constant within 5 lb. per sq. inch, provided that the fluctuations in pressure do not demand a power input into the generator greater than its capacity.

Occasionally it is desired to maintain constant temperature either in a room or in a vessel, and the necessary regulation can be accomplished by varying the input to the steam generator. For this purpose a thermostat or equivalent device, together with the necessary electrical relays, which will operate to hold the temperature within reasonable limits, can be supplied.

As previously mentioned, regulation of the power input and consequently of the steam conditions, is accomplished by adjusting the flow of water to the electrode chamber either by hand or by automatic devices. This provides very fine adjustment and pre-supposes that the resistance of the water will remain nearly constant, but since feed-water is continually being added, the small amounts of various salts, which it contains, gradually accumulate, as they are not carried off in the steam. This accumulation tends to lower the resistance of the water, so that more current will flow for a given depth of electrode immersion, and to prevent this a small quantity of water is continuously extracted from a settling chamber at the extreme bottom of the shell by means of the by-pass round the blow-off valve. This water should preferably be used to heat the make-up water in order to avoid loss of the heat stored in it.

If for any reason the power supply should fail, the water in the electrode chamber will drain out through the openings provided, and thus the generator will be ready to start up at once with reduced load when the power is again available.

It is apparent that the installation of a steam generator earths the neutral of the circuit, through the resistance of the water, to the shell of the generator. The effect of this on the control of other equipment connected to the lines should be considered and provision should be made to take care of it. The shell of the steam generator should be securely earthed by copper cable in order not to depend on the joints in the piping system, which through rust or packing might not provide a good earth connection.

When steam generators are installed on a power system, a high-resistance balanced "earth" is made, and for that reason suitable protection must be provided on the a.c. generator, the feeders connected to the busbars from which the steam generator operates and the steam generator. In general, if the a.c. generator has an insulated neutral, two-coil protection will be sufficient; but if the neutral is earthed, then three-coil protection is necessary.

Steam generators of this type have been developed for voltages from 6,600 to 220 V, steam pressures up to 200 lb. per sq. in., and capacities from 6,000 to 500 lb. of water evaporated per hour.

Electric steam generators, just as other steam generating equipments, are subject to difficulties arising from impurities in the feed water, the impurities causing corrosion of the generator shell and electrodes, settlement of scale and mud in steam traps and valves and a muddy condition of the water in the sight gauges. Where this condition exists, it can be corrected in almost all cases by the addition of a suitable amount of slacked (hydrated) lime to the feed water, and in installations where a feed-water treating apparatus is available it can be so operated as to meet the requirements of the steam generator.

The drawing of this boiler is reproduced by courtesy of The British Thomson-Houston Co., Ltd.

Swiss Hydro-Electric Project.—According to the *Electrical World*, negotiations are proceeding between the St. Gall-Appenzell Electric Power Co. and the authorities of the Glarus for the construction of an unusual type of hydro-electric station to utilise the water power of Lake Mutten, the Limmern Falls, and the Upper Linth River in East Switzerland. The scheme provides for a continuous output of 115,000 h.p. Lake Mutten will supply the water in the winter months, with the Limmern Falls intake as a supplementary feeder, while the River Linth will furnish the power in the summer. The generating station will be installed at Tierfeld, near Linthal, at an estimated cost of $10,292,000.

Mid-Cheshire Electrical Developments.

The Inauguration of Rural Electricity Supply Extensions.

A PIONEER in the use of gas for the generation of electricity, the company formerly known as the Northwich Electric Supply Co., Ltd.—now the Mid-Cheshire Electricity Supply Co., Ltd.—has just completed a big extension of its services. It has supplied electricity in Northwich and its suburbs since 1896, and the recent expansion, including the neighbouring towns of Knutsford, Winsford, and Middlewich, each a separate urban district, has increased its area to a total of about 120 square miles. Mid-Cheshire is the premier salt-producing district in England, and supports an extensive brine-pumping and evaporating industry, including the main works of the Salt Union, Ltd., at Winsford, whilst Northwich is the headquarters of the heavy-chemical firm of Messrs. Brunner Mond & Co., Ltd. The new district embraces three of this firm's principal works, together with an associated undertaking at Middlewich. The electrical possibilities of a big power demand developing will be evident when it is mentioned that, apart from a very large extension to the Winnington works of Messrs. Brunner Mond, the numerous salt and alkali industries have attendant engineering works, including constructional ironworks, shipyards, foundries, machine shops and timber yards, most of them in the Northwich area. At the present time the Weaver Navigation Swing Bridges and the Anderton Boat Lift are obtaining power from the Mid-Cheshire Company.

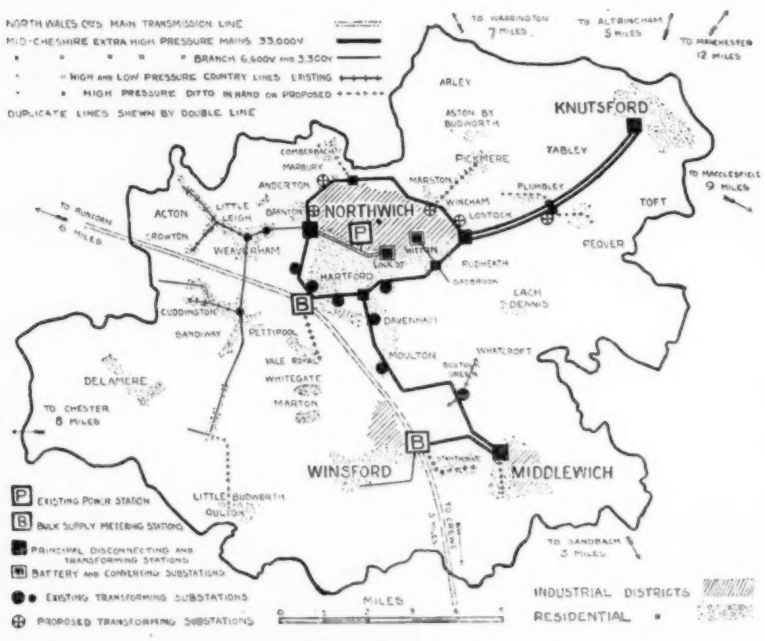


Fig. 1.—The Mid-Cheshire Electricity Supply Co.'s Area.

In Mid-Cheshire, side by side with the working of salt and soda, agricultural activities have come on apace, and flourishing farms are to be found, not only in the rural areas, but close to the works also. Mr. W. Fennell, M.I.E.E., electrical engineer to the Company, states that plans have been prepared for the development of an agricultural demand, and will in due course be submitted to the directors. He has in mind the application of electric power for driving heavy farm machinery, but anticipates that the Company will have to adopt a system for the hire of plant to farmers in much the same manner that electric heaters, cookers, washers, &c., are loaned on rental to domestic consumers. In the area of the Company, there is a large number of farmers; that they will ultimately be connected with the service lines of the Company is a foregone conclusion. As a first step in that direction, an endeavour will be made to introduce electric lighting and cooking to farm premises.

When the Northwich Electric Supply Co. made its initial venture in 1896, the generating plant was driven by three engines, each of 100 h.p., running on Mond gas, the engines being still in service; just before the war the total power plant of the Company aggregated 750 h.p. The next development did not mature until 1919, when the Weaverham electricity undertaking (the only one within a radius of ten miles) was absorbed by the Northwich Company, which obtained authority to extend the area it supplied. The schemes which were then conceived, although held up for a time by the proposed formation of Joint Electricity Authorities, Mid-Cheshire being included in the West Lancashire District, were later proceeded with energetically, and have now been fittingly interpreted. The Northwich power station continues to function, but to meet the demands from the new outside areas, the Company entered into an agreement to purchase a bulk supply from the North Wales Power Company's undertaking in the Crewe area and the Mersey Power Company's station at Runcorn. Local offices, stores, and showrooms will be provided, if necessary, in each of the three towns; premises are ready to be opened in Knutsford, and the Company has modern showrooms and a sales department in Northwich, in addition to a contracting department. The Southern and Eastern sections of the new area were inaugurated on August 17th, and the remaining portion is nearing completion. The transmission line between the two places passes through the centre of the Mid-Cheshire area, and the Mersey Power Co. actually supplies the Mid-Cheshire Company in bulk through the North Wales Power Company's main. The bulk supply is delivered in the heart of the district (1) at Hartford, near Northwich, and (2) near Winsford and Middlewich (fig. 1). The sub-station at Winsford (fig. 2) is one of two points on the North Wales Power Company's duplicate transmission line, from which the supply is taken at 33,000 volts three-phase. The 33,000-volt enclosed oil-break switchgear, situate in the main building, controls the two main connections, and is capable of dealing with a short-circuit current of 500,000 kVA. The sub-station also carries on its roof the 33,000-volt outdoor type oil-break switchgear, which will control the overhead line to Middlewich, and thence it connects through to the Northwich ring main at Davenham. The switches are operated by lever gear situate in the control room, mounted with the metering equipment for the bulk supply. Sets of horn-break isolators for the outgoing oil switch control the two transformers for the Winsford supply, all operated by controls situate in the building below the switches, and a 33,000/3,300-volt transformer provides a high-pressure supply for a feeder which is connected to the distributors at a central point in Winsford, through a step-down transformer. The Winsford supply distributor is connected to the 33,000/380/220-volt transformer at the sub-station. The 3,300-volt cubicle gear and the medium-pressure switchboard for dealing with the local supplies are located in the control room.

The Croxton Lane sub-station, Middlewich, combines a line terminal with a switch structure and a town supply sub-station. The 33,000-volt horn-break switches on the top of the structure can be used to isolate the Winsford-Middlewich-Davenham sections. The lower switches and fuses control the transformers which step-down from 33,000 to 380/220 volts for local use. All these switches are operated from inside the building.

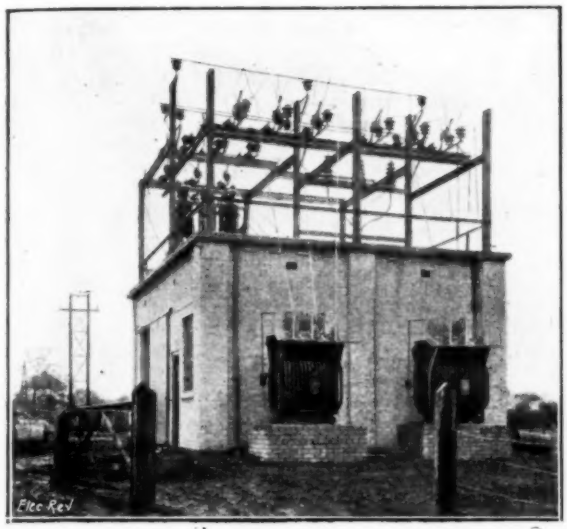


Fig. 2.—Bulk Supply and Power District Sub-Station, Winsford.

The low-pressure switchboard will deal with two transformers and two supply mains. It also contains a master meter and recording ammeter, so that a check is kept of the conditions without any necessity for continual attendance.

The transmission line poles, after leaving Middlewich at Lostock Gralam *en route* for Knutsford, have to be

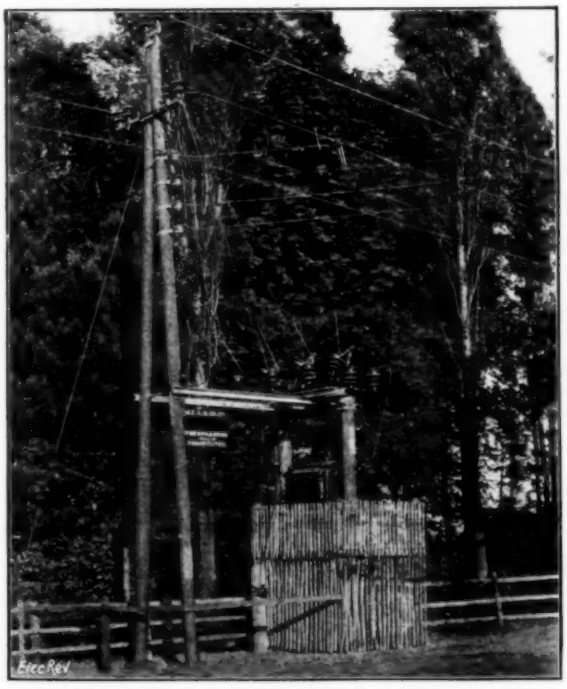


Fig. 4.—Typical Country Sub-Station in Bostock Park.

kept in hedgerows. The result is that, although the farmer may be saved a little trouble, the appearance is not as good as that of an equally spaced pole line. The duplicate 33,000-volt transmission line to Knutsford is connected to the ring main at the Lostock station, and there is a special switching structure containing five switches, enabling several alternative connections to be made. The Knutsford sub-station (fig. 3) is an exact replica of the Middlewich sub-station.

The new sections incorporate improvements which experience with the first section (the 33,000-volt system between the Salt Union's power station at Winsford and the Company's power station at Knutsford, 1924) has suggested. The switching structures and the smaller sub-stations in particular now occupy less space, and

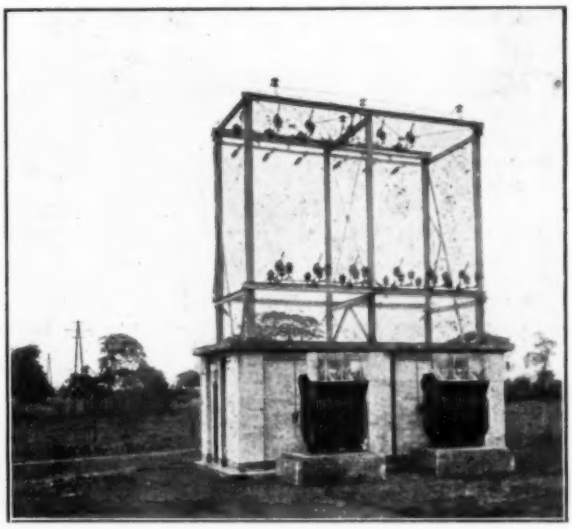


Fig. 3.—District Terminal Sub-Station, Knutsford.

further economies have been effected in construction costs, so that a 33,000-volt line is now tapped safely at a cost of £60 single-phase and £75 three-phase, exclusive of the transformer, while the switch- and fuse-gear has been made more reliable and suitable for local conditions. The new type combined terminal structures and distribution stations are, it is hoped, not only satisfactory from the engineering point of view, but up to the standard of the neighbouring buildings so far as appearance is concerned. There exist, or are being constructed, 21 sub-stations, including two converting sub-stations for Northwich. Up to date there are 15¾ miles of single-circuit 33,000-volt three-phase line and 5½ miles of double line; in addition, there are 23 miles of overhead branch lines and eight miles of 3,000- and 6,000-volt underground mains, apart from the distribution mains in towns, larger villages, and suburbs. The cost of the work has amounted to approximately £85,000.

During a tour of inspection of the new area of supply, visitors displayed particular interest in the new type of suburban and village transforming station with outdoor type M.-V. switchgear. Several of these stations are now in operation, each having cost about £250. Hitherto the high cost of the necessary buildings and switchgear, for even the smaller sub-station tapping a trunk main, amounted to about £2,000, and this prevented small communities from making use of the important power mains passing near them.

Following the inauguration of the new plant, which was switched into service by the chairmen of the urban councils of Winsford, Middlewich, and Knutsford, respectively, Col. J. A. Saner (chairman of the Mid-Cheshire Electricity Supply Co.) referred to the early history of the undertaking and the earlier schemes of the Electricity Commissioners, remarking that it was uncertain whether the district was to be attached to one of the District Electricity Boards. The West-Lancashire District included the greater part of the area, but even now its more northerly portion was under the ægis of the South-East Lancashire District. Another delay occurred owing to the Chester and North-Wales Authority having arranged with the Mersey Power Co. to supply power to Crewe, and as the line was to pass through the Mid-Cheshire area, it was obviously more economical for the Company to obtain a supply in bulk. Nearly £100,000 had been spent on the scheme without subsidy or guarantee from the Government, and a large

proportion of that sum had been spent on local labour. Every item of plant was British, with the exception of the line poles. Colonel Saner urged that the Government should remove more of the remaining restrictions which stood in the way of economical development. One way would be to make it possible to obtain permission to erect lines without so much delay as now frequently occurred. The Postmaster-General should be encouraged to recognise that such companies as their's were giving public service. The Postmaster-General, when he put up a new line adjacent to, or crossing, an existing power line, called upon the latter's owners to pay for the necessary protection of the telephone lines, which was not fair, or equitable. The development of electricity in this country had been retarded by conservative regulations, such as those which forbade the use of overhead lines and limited voltage.

Alderman Walker (chairman of the Manchester Electricity Committee) remarked that there were no frills on this scheme of the Mid-Cheshire Electricity Co. It had been engineered with a view to supplying the consumer at the lowest possible capital cost. That day they had seen the simplest types of isolating links and transformers, and everything was left to the mercies of the British climate; electrical engineers would be interested to see how this type of sub-station served in practice.

Mr. W. M. Beckett indulged in reminiscences, pointing out that not only was the Northwich Company a pioneer in the use of Mond gas, but he believed it was also the first public authority to light a village (Hartford) by electricity. The Company started with ten consumers and 600 lamps; five years later it had the equivalent of 14,000 lamps. whilst to-day the equivalent was 200,000 lamps. In his presidential address to the British Association, Sir John Snell had said that the consumption of electricity in this country was equivalent to 110 kWh per head of the population, but he (Mr. Beckett) advanced the idea that the figure should be at least 500 kWh. At the present time in the Mid-Cheshire district, the consumption per head was 62 kWh, and now that developments had been completed, he expected a rapid increase. The present output was about one and a half million kWh per annum.

Covering urban and rural districts, the scheme has big possibilities. Outside Northwich there is no moving machinery; the smaller sub-stations with their gear and branch lines have been erected by the Company's staff; distributing mains in Winsford, Middlewich, and Knutsford have been laid underground by the Company's staff also. High- and low-pressure cables were manufactured by British Insulated Cables, Ltd., and the l.p. street boxes by Messrs. Sykes & Dyson. Transformers are by the English Electric Co., Ltd., Metropolitan-Vickers Electrical Co., Ltd., Ferranti, Ltd., and the Hackbridge Electric Construction Co., Ltd. The switchgear is of the Metro-Vick and Ferguson Pailin makes, motor converters by Bruce Peebles & Co., Ltd., and meters are used of the Ferranti, Metro-Vick, and British Insulated Cables, Ltd., types.

The Magnetic Testing of Steel.

A New Process for the Location of Invisible Cracks.

THE high stresses imposed upon machine parts in modern engineering practice necessitate rigid inspection from time to time to guard against the development of cracks or flaws which, by reducing the section of the sound metal, impose strains which might lead to total fractures. The cost of breakdowns, and the more serious consideration of injury to life and limb, demand that periodical inspection shall be carried out under the most expert supervision and with the utmost care. In the case of railway axles, where fractures may have grave consequences, inspection is entrusted to expert workmen, whose judgment is generally relied upon as the result of a visual examination. In a few instances, improved means of inspection have been devised, one of which consists of heating the axle and watching for the exclusion of any oil which may exist in any crack. This obviously is not good practice, as it demands the heating of the steel, which is not benefited thereby.*

Fig. 1.—Before Treatment.

Fig. 2.—After Treatment.

The reproductions are from untouched photographs. A, start of crack; B, middle of crack; C, tool mark.

A new process, however, has lately been evolved which should prove a boon to those concerned. The principle, which we recently saw demonstrated at the works of the Equipment and Engineering Co., Hackney, consists of highly magnetising the steel in such a direction that the lines of force flow across the cracks. Magnetic poles are thus formed across the flaw, and it only remains to provide means for detecting the external magnetism to reveal the existence of the defect. This is done by bathing the part tested with an ink or solution containing iron in a finely divided state, the result being that the iron adheres to the crack and clearly shows it up. At the demonstration a crack in an L.C.C. tramcar axle was unrecognisable in the first place, but directly the detecting ink was applied, it was made visible. Figs. 1 and 2 show the portion of the axle in question before and after the application. The apparatus which was used for this test is experimental, and consists of a large electromagnet with extended pole pieces conveniently machined to embrace the axle, fig. 3. It is carried by an overhead travelling crane. The coil, which is highly inductive, has a special sectional method of winding to guard against trouble due to the induced discharge pressures. The control switch is arranged with non-inductive discharge circuits which are connected across the ends of the coil at the moment of switching off. The power consumption of the magnetising element is only 150 W. The demonstration apparatus also included a special magnet, fig. 4, used for the testing of steel pinions. The pinion is clamped in this, and after the coil has been energised for a few seconds it is removed and the pinion is immersed bodily in a bucket of the ink; upon its withdrawal any cracks that may exist are revealed.

For the testing of such equipments as railway axles or locomotive crankshafts, various designs of apparatus are being evolved on the principle represented in fig. 3, and smaller parts will be dealt with by similar appara-

* See also "Flaws in Metal Surfaces," ELECTRICAL REVIEW, August 13th, 1926, p. 268.

tus to that shown in fig. 4. Again, large hollow magnetising coils will be used for dealing with such articles as connecting rods and similar parts.

The ink used has perhaps given the most trouble in the production of the equipment for commercial use, and the fact that it became magnetised on first use, to such an extent that each minute grain became a magnet, was a source of much difficulty. This resulted in subsequent tests in the free iron adhering to the part under test more or less all over. Attempts made to demagnetise the ink did not meet with much success, and it was not until a method of producing a practically pure iron in a finely granulated form, by heat and chemical treatment, was invented that success was attained. Even now the utmost care has to be taken of the particles, and to this end they are held in suspension in a special hydrocarbon solution treated to prevent the entry of water, which would soon render the free iron useless. The preparation of this ink has so far been carried out in small quantities in the laboratory of the Equipment and Engineering Co., but we understand that the company is now installing a plant for the production of the fluid in commercial quantities.

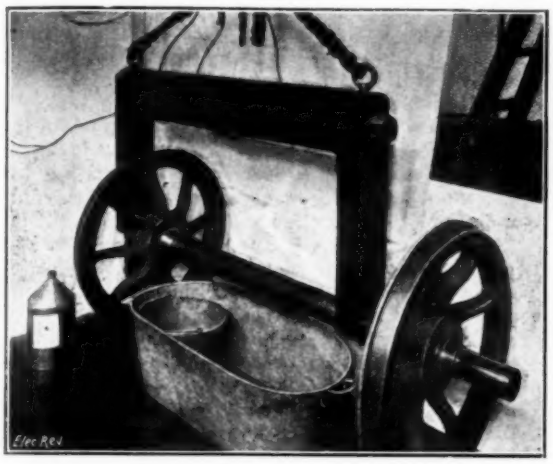


Fig. 3.—Axle-Testing Equipment.

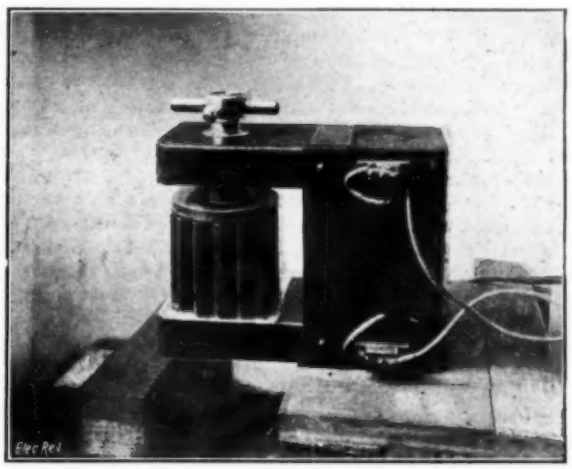


Fig. 4.—Pinion-Testing Model.

It is almost impossible to conceive the vast field of utility to which the process can be applied, and already the call for special designs of the apparatus to allow for the testing of different machine parts has taxed the designers somewhat severely.

Our thanks are due to the makers for their courtesy in demonstrating the apparatus to us.

Fundamental Terms and Units.

The Necessity of Exact Definition.

By Professor Wm. CRAMP, D.Sc., M.I.E.E.

In science, to convey exact ideas, exact definitions are necessary. Such definitions are the primary tools of the professor or teacher; they are also essential to the writer of text-books or of technical papers. No further excuse, therefore, is needed for the attempt by the British Engineering Standards Association to compile a "British Standard Glossary of Terms used in Electrical Engineering." Nor will anyone wish to minimise the services already rendered by the Association in producing specifications for the construction and performance of standard machines and instruments; it is generally admitted that many of these pamphlets are of great value to the industry. But in the "Glossary of Terms" just published it has been found necessary to begin with a section which deals with fundamental conventions and units. This is in another category altogether from that of agreed specifications, or even from the definitions of technological terms; and it is no disparagement of the manufacturer to state that, while the name applied to a particular piece of apparatus is primarily his concern, the definition of fundamental terms and units is much more within the province of his academic colleague. It is impossible for anyone to teach a subject like Electrical Engineering unless he is first perfectly clear about the meaning of the terms he employs and the dimensions of the units in which he will make his measurements. Thus every year the teacher expounds anew the fundamental conceptions, and he is consequently much more at home in their expression, and they are of much more importance to him than to the designer or works manager, who largely takes them for granted.

Under these circumstances, it would have been courteous on the part of the B.E.S.A. to have submitted the whole of Section I of its new book to a committee of those concerned in the teaching of electrical engineering. This would have avoided the necessity for the recent paper before the British Association by Professor Howe*, and it would have reduced to a minimum the unfortunate blunders which have occurred in this Section. A perusal of pages 5 to 26 is sufficient to produce the conviction not only that the book is not worthy of the previous work of the B.E.S.A., but that Professor Howe's strictures are certainly justified, and that the volume could neither be included in a University library for the use of students, nor be accepted as a safe guide for the International Electrotechnical Commission.

It is not surprising that difficulty should have been experienced in trying to define some of the fundamental terms, but it is surprising that elementary mistakes should have been made. Many of these have been referred to already by Professor Howe, but there are at least as many more with which he had no time to deal. For instance, No. 1,510 defines a dyne as follows: "It is that force which, acting on a mass of one gramme, gives to it an acceleration of one centimetre per second." Surely it is recognised by this time that the dimensions of acceleration are not those of velocity? One might be inclined to think that this was a misprint, were it not for the fact that a similar mistake occurs in an elec-

* See this issue, p. 355 *et seq.*—EDS.

trical engineering text-book (by an A.M.I.E.E.) published in 1923, wherein the following statement is found: "The unit dyne is expressed in terms relative to mass, space and time; that is the effect it has upon a mass of one gramme having an acceleration of one centimetre per second." This seems to me to be sheer nonsense, but it is comparable with the former, since in both definitions the dimensions of acceleration are misunderstood. It was to such fundamental errors as these that attention was particularly directed in the discussion at Oxford. Professor Howe gave instances where the B.E.S.A. had failed to distinguish between cause and effect. Professor F. G. Baily put the matter more generally by insisting that the physical dimensions of a quantity were independent of the actual unit employed, and that the B.E.S.A. document confused quantities of different dimensions. There is a third way of expressing the same idea, namely, that energy in any form may be expressed as the product of a quantity factor and an intensity factor, and that some of the B.E.S.A. definitions have confused these two. It is not possible to over-rate the seriousness of the situation, and I agree with Professor Howe in thinking that the B.E.S.A. should withdraw the book from publication until it has been revised.

In the revision it will be necessary to decide upon the system of tubes of force into which an electrostatic or a magnetic field is conventionally divided. Uncertainty exists because the early physicists used a system for the electrostatic field different from that which they adopted for the magnetic field. We may distinguish the two conventions by denoting them as the "Faraday" and "Maxwell" systems respectively. In the case of Faraday tubes, unit charge is regarded as giving rise to one tube; in the case of Maxwell tubes, unit charge is regarded as giving rise to 4π tubes. The former is commonly adopted by physicists for electrostatic problems. Thus, for instance, Sir J. J. Thomson, in "The Mathematical Theory of Electricity and Magnetism," adheres to it throughout. The Maxwell convention is similarly universally adopted by physicists for magnetic problems. Professor Howe thinks, and I believe Professor Marchant agrees with him, that Maxwell tubes are adopted by teachers of electrical engineering for both electrostatics and magnetism. The B.E.S.A. Committee has adopted Faraday tubes for electrostatics only, and Professor Howe objects to this. It seems to me that it would be desirable to use the same convention for both magnetism and electricity, but it is not essential. What is required is that there should be unanimity as to which of the conventions shall be adopted in this country. At present, even in reputable text-books, both systems are used without any clear explanation. For instance, in Dr. Wall's book on electrical engineering, published in 1921, the following statement occurs on page 13: "From unit surface in air, on which the density of the electric charge is $+\sigma$, $4\pi\sigma$ unit lines of force start, and on unit surface on which the density is $-\sigma$, $4\pi\sigma$ unit lines end." If we now turn to page 64 of the same book, where electrostatics is still being dealt with, we have the following statement: "Suppose that the field is mapped out by tubes of force, such that each tube starts from a unit of quantity on the positive boundary and ends on a unit of quantity on the negative boundary." Thus, in the same book and upon the same subject, the author has used the Faraday and Maxwell conceptions without giving any adequate reason for his change from one to the other. In the mind of the student this induces a feeling of despair, which it is the business of the teacher to remove. If the B.E.S.A. Committee had done no more than clear up this one point, it would have been worth while. Unfortunately its definitions only make matters worse.

Another question which might be discussed with great profit is the desirability or otherwise of making reference to the Heaviside system as developed by Karapetoff. In this case the whole of the electrical units are accepted frankly as arbitrary, which must inevitably be the case so long as the dimensions of permeability and specific inductive capacity are unknown. It is in this system that the term "permittivity" has arisen, which the B.E.S.A. has regarded as an alternative to "specific inductive capacity." It is true that the two terms may represent quantities of the same dimensions, but the magnitudes differ, for in the Karapetoff electromagnetic system the permittivity of air is 0.088×10^{-6} microfarads per cm.^{3}, the microfarad being a unit derived from arbitrary definitions of the ampere and the ohm. When a term like permittivity has been definitely associated with a system of units, it is confusing to use it in connection with another system, and it is therefore a question whether it would not be desirable to remove from the B.E.S.A. list all names which have a definite association with the proposals of Heaviside.

It is satisfactory to relate that the British Association has empowered a Committee to go into the whole of these questions, and the object of this article is not in any way to forestall the action of that Committee, but merely to assist beforehand in clearing up some of the misunderstandings.

The spelling that the B.E.S.A. is attempting to introduce is a matter of secondary importance compared with those just discussed; but I think that it should also be considered by the B.A. Committee. It is not the function of a technological body to standardise the English language, and any such attempt as that made in the new volume is foredoomed to failure. Indeed, the B.E.S.A. Committee itself has admitted its failure by deferring to "long-established usage," and thus re-introducing the very divergence which it is its object to avoid. Nor is the definition of long-established usage at all clear. I should have thought, for instance, that "starter" was a word of at least as great antiquity as "balancer," "booster," or "breaker," yet the first is included as a term of "comparatively recent origin," and therefore is now to be spelt "startor," while the others are still to retain the "er." I should like to see the whole of paragraph 11 on page 8 deleted and the spelling of the text revised, so as to adhere to established custom. The decisions arrived at are unsatisfactory and very arbitrary. If it is desired to reach any such conclusions, the proposal should be referred to acknowledged experts in the English tongue.

A Novel Time Recorder.—Over a year ago three Frenchmen invented electrical apparatus, to be attached to a telescope, for the purpose of recording the exact instant at which the image of a star crosses the centre line of the field of a telescope. Now a young Danish engineer has perfected the work of the Frenchmen, says the *Evening News*, which explains that the method is, roughly, as follows: At the eye-piece end of the telescope is a photo-electric cell, in front of which is a plate with slits in it, so that only at the moment when the star is in the centre of the telescope's field will its light reach the photo-electric cell. The current which is then generated loads one grid of a special valve, with two grids, by means of which the slightest alteration in the potential of the grid connected to the photo-electric cell is highly magnified. It is further magnified by a 4-valve amplifier, so that it will work a relay, which makes the record on a tape. As the star passes each of the slits in the plate between the telescope and the photo-electric cell dots are recorded on the tape so that the exact mid-point can be read with fine accuracy. There is a certain time-lag, caused by the pause while the current loads the grid of the 2-grid valve, but this is a fixed factor of about one-tenth of a second, and can be allowed for. It is stated that Mr. B. Stromgren, son of the director of the University Observatory at Copenhagen, has so perfected this apparatus that a star of the eighth magnitude, far too faint to be visible to the naked eye at all, records its passage. The importance of the invention is that it secures increased accuracy in the measurement of time.

Magnetic Braking Test.—Particulars are given in the *Electric Railway Journal* of some braking tests which were carried out on a locomotive on the Buffalo and Erie Railway. A section of straight track about 700 ft. long was selected, and the heads of both rails were coated with heavy car oil. A car equipped with magnetic and air braking was then run on the greased section at a speed of 45 m.p.h., and both magnetic and air brakes were applied. The car stopped in 470 ft. A second test was made under the same conditions, except that only the air brakes were applied. The car in this case went through the 700 ft. of oiled track and was stopped on the dry track, 85 ft. beyond the oiled section. The test comparisons are more favourable for the magnetic brake than appears from the figures, because during the first test some of the oil was removed from the rails which had been sanded.

The Remote Control of Broadcast Receivers.

Two-Station Selection and Distant Switching.

By P. E. K. HOLE, Student I.E.E.

THERE are undoubtedly a great many people who, although they enjoy broadcast radio-telephony, are somewhat daunted by the apparent complexity of the controls, or grudge the space taken up by a receiving set and loud speaker in the room most generally used. Some people get over the lack of space by fitting the set in one room and running wires to the loud speaker, which is used in another room. This, however, still requires the switching on and off of the set and the tuning to be done at the set, and not in the room where the loud speaker is situated. The following shows how this limitation can be avoided.

The type of set best suited to remote control should have the following characteristics: It should be (1) fairly broadly tuned, and (2) not critical as regards filament control. It will be found that the most suitable set will

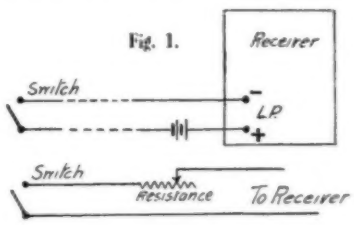


Fig. 1. Fig. 2.

embody a 3-valve "straight" circuit consisting of a detector (with or without reaction) and two low-frequency amplifiers. Assuming that only one station (say, London) is required, having once tuned in, the set may be left always tuned and the filament resistances always "on," and then it will be only necessary to switch on the filaments by means of an ordinary lamp switch placed in the same room as the loud speaker. The necessary connections between the set and the switch can be made by means of No. 18 gauge vulcanised india-rubber covered wire, as shown in fig. 1. If it is necessary to control the loudness of signals as well, then it is only necessary to insert a resistance (capable of carrying the current required by three valves) in circuit near the switch, as indicated in fig. 2.

If a choice of two stations (say, London and Daventry) is needed, it will be necessary to alter the tuning when changing from London to Daventry, or *vice versa*. It

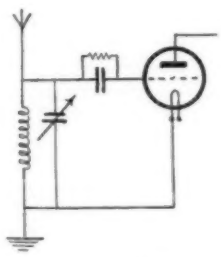


Fig. 3.

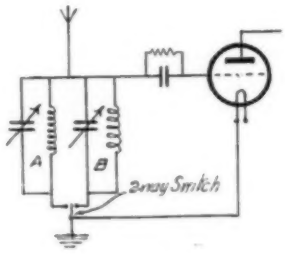


Fig. 4.

will also be found that, although reaction may not be required for reception from London, it will generally be required to enable Daventry to be heard by people near London. The following shows how it is possible to change over from London (without reaction) to Daventry (with reaction) by remote control: To understand how this can be done, it is necessary to consider a few details of tuning. Fig. 3 shows a simple tuner and detector without reaction (it is unnecessary to show the batteries or the amplifiers). It is obvious that by altering the coil and retuning, it is possible to alter the wave-length as required. It is also possible to change from one given wave-length to another by employing two tuners coupled to the valve by means of a 2-way switch, as shown in fig. 4, which supposes A to be tuned to one of the wave-lengths and B to be tuned to the other. This method requires two variable condensers, but it is possible to use only one variable condenser, as indicated in fig. 5, though it will in that case be necessary to arrange that the two stations "come in" at the same condenser reading, *i.e.*, if London "comes in" at 60 deg. on the condenser with coil A, then coil B must have such a value that, when it is shunted by the condenser at 60 deg., it will just tune in Daventry. The 2-way switch can be fitted at a distance from the set, to which it is connected by means of three wires. If re-

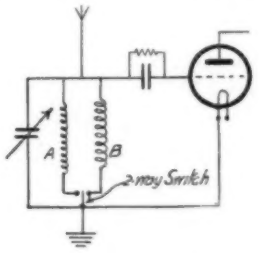


Fig. 5.

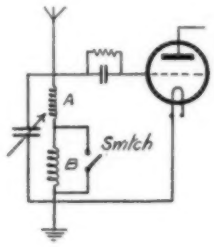


Fig. 6.

action is required to hear Daventry, it will be necessary to fit a reaction coil and couple it to B coil in such a way that it cannot affect A.

Another method of changing over which only needs an ordinary 1-way switch and two wires between the set and switch is shown in fig. 6. When the switch is closed, only A is in circuit, but if the switch is open, then both A and B are in series, while the condenser is in circuit the whole time. The values of A and B should be such that when A only is in circuit (tuned by, say, 60 deg. on the condenser), it will tune in London, but when A and B in series are tuned by the same reading on condenser, they will give Daventry. If it is found that London can still be heard when using the above arrangement for reception from Daventry, due to the set being unselective, it will be necessary to incorporate a rejector circuit consisting of an inductance coil and a variable condenser in series.

A rejector circuit of this type is usually connected between the aerial and earth, but if so connected, it would

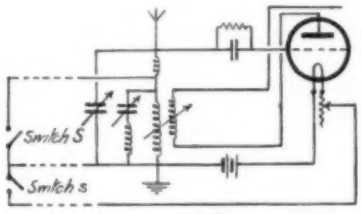


Fig. 7.

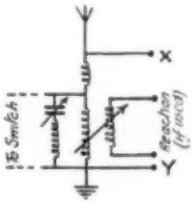


Fig. 8.

remain in circuit when the switch was in the London position, and would, therefore, be of no use. If, however, the series rejector is connected directly across the inductance B, it will be found satisfactory, as it will only be in circuit when the switch is open, *i.e.*, in the Daventry position. In fig. 7 is shown a diagram of a tuner arranged for two-station remote control, including reaction on Daventry, and a rejector circuit arranged to cut out London when the set is tuned to Daventry. Of the three wires leading from the set to the two switches it

will be noticed that the middle wire is common to both switches, and it is possible to get the following remote control:—

Switch *s* open .....Filaments out.
Switch *s* closed.....Filaments alight.
Switch S open .....Set tuned to Daventry.
Switch S closed.....Set tuned to London.

With regard to practical methods of applying the foregoing method to existing sets, as there will probably be no room on an existing set for the extra coils, &c., required, it will be found easiest to make up a separate panel and attach it by wires to the set. The circuit of the panel should be as shown in fig. 8. The reaction coil should preferably be fixed (not movable), and the best way to arrange this is to fix two plug-in coils about two inches apart and to do without a coil holder. The panel is connected to the set as follows:—

(i) If the set employs parallel tuning, join X to the aerial terminal of the set and Y to the earth terminal; remove the tuning coil from the set and leave the coil socket open.

(ii) If the set employs series tuning, join X to the earth terminal of the set and Y to the aerial terminal; remove the tuning coil from the set and put a short-circuiting plug in the coil socket. In both cases the tuning condenser on the set will still be used for tuning. If reaction is required and the set already has a reaction coil, then it is only necessary to remove the coil from, and make connection to, the panel by means of a piece of twin flex connected to a coil plug which is inserted in the coil socket previously occupied by the reaction coil.

Business Notes.

Commercial and Industrial Developments, Business Changes, Trade Opportunities, New Publicity Literature, Liquidations and Failures.

Our Trade Names Supplement.—Those who wish their Trade Names to appear in our September issue and who have not yet sent in the completed forms are asked to note that they should be returned to us before August 31st. A notice to this effect appears in our advertisement columns, page Sup. 38.

The British Industries Fair.—So great has been the number of applications for space at the Birmingham section of the British Industries Fair next February that it has been decided to build extensions which will give a further letting area of approximately 30,000 sq. ft. In the London section, more than six months before the Fair opens, applications for space are already within 20,000 ft. of the total for the last Fair. In order that every possible facility may be afforded to buyers attending the Fair from abroad, the Government has decided that holders of the official invitation card may have their passports to England visaed, in cases where visas are necessary, without any charge being made.

The South African Market.—In a letter to the *Wireless Trader*, a member of a Durban firm of radio apparatus dealers draws attention to the size of the Union of South Africa and the futility of appointing an agent in, say, Johannesburg, to deal with business for the whole of the country. He says that Americans, who have studied the market, do not make this mistake. Again, it is pointed out that distributors' costs in South Africa are so heavy that the ordinary English retail prices provide an inadequate margin; these prices should therefore not be printed in catalogues, &c., for public information.

Lead.—Messrs. James Forster & Co., in their letter dated August 21st, state:—"Closing prices yesterday were £32 17s. 6d. for August and £32 8s. 9d. for November, an advance of 8s. 9d. and 6s. 3d. per ton respectively on the week. Anticipation of a speedy settlement of the coal trade dispute was probably the cause of the slight increase in speculative dealing on this week's market and the consequent advance in prices. Consumers are little in evidence except for a few prompt parcels and they show no disposition to anticipate forward requirements. In the meantime arrivals are on a larger scale than for the last two months and will amount to date to about 13/14,000 tons, including to-day's arrivals. Germany has not been buying this week. France has actually re-shipped Mexican and Colonial lead to this market this week, having apparently more than she needs. The floods in Burma which have disorganised transport for the time being and the political unrest again apparent in Mexico are 'bull' points, but on the whole we look for steady markets without much change in values. The Board of Trade returns for July show:—Imports, 16,980 tons, exports 2,683 tons, leaving for home absorption 14,297 tons."

British Manufacturers and Guatemala.—In a recent article contributed to the *Daily Mail*, Mr. F. A. Mitchell-Hedges, the explorer, accuses British manufacturers of lack of enterprise in their dealings with Guatemala. He says:—"For the purpose of opening up the country the Guatemalan Government determined to have an electric railway constructed on the Pacific side connecting the existing railway at San Felipe with the second largest town in the country and at the same time to have a big electrical power station erected to distribute power and light to the city of Guatemala, 100 miles distant. The contract, which amounts to more than £1,000,000, was offered to Great Britain. There was no question about the money being forthcoming, yet none of the large contracting firms in England even took the trouble to make inquiries. The result is the contract went to the A.E.G. in Germany, who have constructed a great dam across the River Samala, built the power house, and are already well advanced with the railway."

International Electrical Co-operation. — Dealing with reports of a proposed interweaving of German electrical interests with those of the western countries, a report from Amsterdam states that both the French and Belgian electrical industries are provisionally opposed to co-operation with their German competitors, as they apprehend that their interests would be prejudiced by the grant of large orders to the German industry on reparation account. M. Loucheur is said to have formerly been in favour of a union of the interests of the German and French electrical industries, and he prepared some time ago a scheme for the utilisation of French water powers, the reorganisation of the electrical industry, and the modernisation of the railway, telephone, and telegraph services. In this connection the circumstance is recalled that a large place was occupied in connection with the negotiations between the Marquis de Lubersac and Herr Stinnes by the question of the supply of northern France with electrical energy from German power stations. American concerns are also reported to be desirous of co-operating with the German electrical industry in industrial and financial transactions in connection with the large orders expected by Germany for the electrification of the Belgian and French railways and the reorganisation of the telephone and telegraph services on reparation account. During the recent economic negotiations between Germany and France, the representatives of the former are stated to have suggested an association of the interests of German, French and Belgian industries.

Bankruptcy Proceedings.—S. PATTERSON, 55, Aberdeen Walk, Scarborough, electrician.—The public examination of this debtor was held on August 17th, at the Court House, Scarborough. The statement of affairs showed liabilities of £551, against assets of £55, with a deficiency of £496. Debtor attributed his failure to bad trade during the past three months, pressure by creditors, and want of capital. He said he commenced business in January, 1924; he had previously been employed as an electrician. He had no capital when he commenced business. The profits averaged about £3 a week, and were used for household and personal expenses. Referring to the forced sale of stock, debtor said there were times when he sold goods at less than the proper retail price because he wanted money, but he did not intentionally sell goods at less than retail price. The examination was closed.

A. B. HAWKINS and H. HAWKINS, electrical engineers, trading as Hawkins Bros., 101, Station Hill, Kidderminster.—The receiving order in this matter was made on debtors' own petition recently. According to the statement of affairs, there are liabilities of £384 and assets of £33. Debtors attribute their failure to lack of capital, bad trade, and heavy costs of judgments. The debtors commenced business in partnership in September, 1919, as electrical engineers with a capital of £20. In September, 1920, they moved, and extended the business to include radio engineering. In March, 1924, they again removed to their present address. Up to 1923 the business did fairly well, but owing to slump in trade and poor conditions generally, business fell off. Creditors began to press for payment about eight months ago. Some were paid on account, but the heavy costs of judgments and summonses severely handicapped the debtors, and they were obliged to file their petition. No books had been kept. Debtors state that they became aware of their position about eight months ago, and since that date have contracted debts with some of their creditors in the hope that trade would revive.

H. L. WOOD, 7, Taswell Road, Southsea, Hants., electrical engineer.—The adjourned public examination of this debtor was held recently at the Court House, Portsmouth. At the previous hearing a statement of affairs was presented show-

ing liabilities of £4,069, against assets of £85, leaving a deficiency of £3,984. Debtor said he was now employed as manager of the business which was formerly owned by himself and his wife, and any debts incurred during the partnership his wife would be responsible for as well as himself. Referring to certain share certificates, debtor said he knew that on the formation of the company he and his wife were to get 498 shares, but he had not received his portion. It was decided that the examination should stand adjourned for the share certificates to be procured.

G. C. BARNES, Regent Electrical Works, Royal Street, Barnsley, Yorks., electrical engineer.—The public examination of this debtor was held recently at the County Court Hall, Barnsley. The statement of affairs showed liabilities of £482, and there was a deficiency of £136. Debtor attributed his failure to a judgment against him for £98 and costs in a law suit at Bradford. He alleged that all his books had been destroyed in an accident, in which his car was set on fire. The examination was adjourned.

E. BOULD & SONS, electrical engineers and plumbers, Huddersfield.—A meeting of creditors was held at Huddersfield County Court on August 18th. The liabilities estimated to rank for dividend were stated to be £6,776, and the assets, after deducting preferential claims (£487), were expected to produce £2,154, leaving a deficiency of £4,622. Messrs. H. V. Wood and E. S. Etchells, of Huddersfield, were appointed joint trustees, with a committee of inspection of the three chief creditors.

F. F. GREGORY, electrical engineer, 2a, Westbourne Road, Luton.—First and final dividend of 6¼d. in the £, payable at the Official Receiver's office, The Parade, Northampton.

T. SCOTT and J. CAMPBELL (T. SCOTT & Co.), wholesale electrical suppliers, 42, Handyside's Arcade, Percy Street, Newcastle-on-Tyne.—Supplemental dividend of 4d. in the £, payable September 2nd, at the Official Receiver's office, Pearl Buildings, 4, Northumberland Street, Newcastle-on-Tyne.

H. PADGETT and A NICHOLSON (Padgett & Co.), electrical and radio engineers, 218, Spring Bank, and 10, Beverley Road, Kingston-upon-Hull.—Receiving order made August 18th on debtors' own petition.

A. B. HAWKINS and H. HAWKINS (Hawkins Bros.), electrical engineers, 101, Station Hill, Kidderminster.—First meeting August 30th, at the Lion Hotel, Kidderminster. Public examination, September 27th, at the Town Hall, Kidderminster.

Mrs. J. A. M. JAMES (Fuchsiaphones Installations), wireless dealer, 9 and 11, Mill Street, Middleton, Lancs.—First meeting, August 30th, at the Official Receiver's offices, Byrom Street, Manchester. Public examination, November 10th, at the Court House, Oldham.

G. V. COOKE (Wakefield Welding Co. and the Albion Accumulator Service), welder and accumulator charger, 80, Ings Road, Wakefield.—Last day for proofs for dividend, September 4th. Trustee, Mr. B. S. Briggs, Official Receiver, 21, King Street, Wakefield.

Company Liquidations.—CASTELLINA CO., LTD., alabaster importers and radio and electrical dealers, Gt. Marlborough Street, W.—A meeting of creditors was held on August 17th, when the chair was taken by the liquidator, Mr. E. W. Smith, C.A., 49, London Wall, E.C. A statement of affairs presented disclosed liabilities of £2,300; of that amount £946 was due to unsecured creditors, the balance being the deficiency as regarded the debenture holders. There were debentures amounting to £4,300, and the assets, after allowing £173 for preferential claims, totalled £2,946, leaving nothing available for the unsecured creditors. The liquidator reported that he had been appointed receiver for the debenture holders and the stock had been sold by him for £1,500. The company was formed in September, 1922, with a nominal capital of £3,000. It had never traded at a profit, and the present position had been brought about by the issuing of a writ by an Italian creditor and certain property which the company owned in that country had been seized. The turnover had been in the neighbourhood of £6,000 per annum. The company dealt in alabaster bowls, certain electrical fittings and equipment, and recently in radio apparatus. The creditors decided that the meeting should be adjourned for seven days with a view to the debenture holders or the directors submitting an offer of not less than 10s. in the £ to the unsecured creditors. The following are creditors:—

	£		£
Southgates	44	Michels & Sohne	67
Anglin & Co.	42	Dwyer & Co.	24
Bennett & Fountain	29		

JENNER LIGHT & POWER CO., LTD., 16, Hart Street, Bloomsbury, W.C.1.—A meeting of creditors was held on August 18th, at the Institute of Chartered Accountants, E.C. Mr. R. H. McKerrow, C.A., Wimbledon, the liquidator of the company, reported that the ranking liabilities were £1,251, all due to unsecured creditors. In addition, there was a secured creditor for £27, who held a charge on a contract valued at £35. The assets were estimated to realise £305 net, leaving a deficiency of £946. The company was registered in August, 1920, with a nominal capital of £5,000, and it took over a business which had previously been carried on by Mr. H. Jenner. The goodwill was then valued at £1,098, and ordinary shares to the value of £1,000 were allotted to the vendor. Preference shares for £982 were also issued for cash. The present position was attributed to lack of capital. At the outset the company traded at a profit, but in subsequent years losses were sustained. During the year to May, 1925, the loss on the trading was £300, and the profit and loss account then showed accumulated losses of £610. During the year to May, 1926, there was a loss on the trading of £519, and the directors decided upon voluntary liquidation. The liquidator said that there were two contracts; the principal one was with St. Thomas's Hospital for £1,428, and up to date £188 had been spent on it. Apparently the contract was for so much a point, and on that basis only work to the value of £99 had been done, but the company had received £100 from the hospital. The other contract was with the Office of Works, for £136. The amount spent had been £47 odd, and nothing had been received. On his appointment as liquidator he gave the usual notice, and he was informed that other firms were completing the contracts. It was decided that an application should be made to the Court for the appointment of Mr. W. A. J. Osborne, of Messrs. Corfield & Cripwell, Balfour House, Finsbury Pavement, E.C., as the liquidator of the company, together with a committee consisting of the representatives of Belco, Ltd., the Walsall Hardware Co., and the General Electric Co., Ltd. The following are creditors:—

	£		£
Belco, Ltd.	311	Sun Electrical Co., Ltd.	62
Walsall Hardware Co.	254	Manufacturing Engineers ...	51
General Electric Co., Ltd. ...	243	Foster Engineering Co.	40
Marshall, E.	104	McKerrow, R	22

SCARBOROUGH ELECTRIC SUPPLY CO., LTD.—Winding up voluntarily. Liquidators, Mr. A. A. C. Swinton and Mr. W. S. Robinson, Alma Chambers, Scarborough. A meeting of creditors is called for August 30th, at 6, York Place, Scarborough. Particulars of claims to the liquidators forthwith. (This notice is purely formal; all creditors have been or will be paid in full.)

BRISTOL & SOUTH WALES ELECTRIC WELDING CO., LTD.—A meeting of members is called for September 20th, at 5, St. Andrew's Crescent, Cardiff, to hear an account of the winding up from the liquidators, Mr. J. W. Williams and Mr. P. Jones.

BURNDEPT, LTD.—A meeting of members is called for September 24th, at 9, Drapers Gardens, E.C., to hear an account of the winding up from the liquidators, Messrs. W. W. Burnham and P. J. Chaplin.

FULLER'S UNITED ELECTRIC WORKS, LTD.—First meeting of creditors and contributories, September 9th, at Carey Street, W.C.

Private Arrangements.—GOODCHILD, CHAPMAN & Co., 357, High Road, Wood Green, N., electrical engineers, &c.—At the adjourned meeting of the creditors herein it was reported that the suggestion made at the previous meeting would be carried out, and that an offer had been received to purchase the creditors' claims for 5s. in the £, payable as to 2s. 6d. in cash, and the balance within twenty-one days. The offer was unanimously accepted.

J. GROGAN, trading as John Grogan & Co., electrical engineer, 95, Waterloo Street, Glasgow.—The creditors interested herein met recently, when a statement of affairs was submitted which showed liabilities of £3,186; of that amount £217 was due to trade creditors and the balance to the bank. The assets, after allowing £26 for preferential claims, amounted to £453, leaving a deficiency of £2,733. The debtor started business in December, 1924, the purchase price being £2,900, which was made up of stock £1,450, and book debts £1,450. The debtor started business without capital, but he obtained an overdraft from the bank. The present position was attributed to depreciation of stock and bad debts. The accounts prepared showed that for the year to June, 1925, the debtor made a loss of £857, and for the period of August 5th, 1926, a further loss of £725. No offer was made, and it was decided that the estate should be dealt with under a trust deed in favour of Mr. Gemmill, accountant, Glasgow, with a committee of inspection.

Receiver Appointed.—WELCO PATENTS, LTD., Birmingham. Mr. E. Greenhill, 7, Newhall Street, Birmingham, has been appointed receiver by a debenture holder of the company.

The German Iron and Steel Industry.—The British Consul-General at Cologne informs the Department of Overseas Trade that according to the report of the Iron and Steel Association (Eisen-und Stahlwaren Industriebund), the position in the iron and steel industry did not improve during July. In the Westphalian provinces the drastic curtailment and stagnation continued, and the outlook still appears very bad. In the foreign market, competition from France and Belgium is becoming noticeably stronger. In the reports of the Remscheider branches, no improvement was recorded. Complaints have been made concerning renewed attempts at dumping from abroad, and price cutting is rampant. The Schmalkalden concern has not been able to report an improvement in business. The prospect of an improvement in the near future of the iron and steel industry in general is not favourable. A change for the better cannot be assured until the Government at last determines to take measures to come to the assistance of the industry.

Social Event.—The annual sports organised by Tucker's Athletic and Recreation Club will take place to-morrow (Saturday) at the Redfern Road ground, lent by the Co-operative Wholesale Society.

Swedish Turbo-Generators for Italy. — The Svenska Turbin Aktiebolaget Ljungström (S.T.A.L.) has delivered the first of three turbo-generators of 20,000 h.p. each, ordered by the Società Ligure-Toscana di Elettricita, of Leghorn. These generators are constructed exclusively with Swedish material by Swedish engineers and workmen. The steam turbines are made by S.T.A.L., and the electrical details by the Allmänna Svenska Elektriska Aktiebolaget.—*Reuter's Trade Service* (Stockholm).

A Finnish Fair.—A Finnish Food Fair is to be held at Helsingfors during the first week in October, and, states the *Board of Trade Journal*, it will provide an opportunity for foreign firms to exhibit machinery and apparatus used in food production. Among the classes of apparatus which will form part of the exhibition are refrigerators and electric cookers. Particulars can be obtained from the Finnish Consulate-General, 57, Gordon Square, W.C.1.

Canadian Department Stores.—The Department of Overseas Trade has received from Canada a list of the principal department stores in the Dominion, showing under 62 headings the articles in which these stores are interested. The articles include vacuum cleaners; electric light fittings, including lamps and shades; and radio sets and accessories. A copy of the list can be obtained from the D.O.T., 35, Old Queen Street, S.W.1. (Ref. 19915/1926.)

Trade Announcements.—THE STEAM FITTINGS CO., LTD., has changed its name to the DRAYTON REGULATOR & INSTRUMENT CO., LTD.; no reorganisation or other change is involved.

Owing to the expansion of their business, MESSRS. ISENTHAL AND CO., LTD., have moved from Willesden to Ducon Works, Victoria Road, North Acton, W.3.

The business of Mr. L. J. WOLF, Putney Bridge Road, S.W.15, has been incorporated with that of the WAGNER ELECTRIC SUPPLIES, LTD., 66, Victoria Street, S.W.1. The company deals with motors of American manufacture.

Mr. L. G. HARVEY will shortly open premises at Courtenay Street, Newton Abbot, as an electrical contractor.

Capt. H. BELBIN, until recently managing director of Belbin & Bowden, Ltd., has been appointed manager of the Beko Lamp Co., Ltd., Fitzalan House, Arundel Street, W.C.2. Capt. Belbin has just returned from a visit to the Continent on behalf of the latter company.

United States Electrical Exports.—During the second quarter of the current year electrical machinery and apparatus of the value of $21,300,000 was exported from the United States. The total for the preceding quarter was $19,900,000, and that for the April-June quarter of 1925 was $17,500,000.

Chinese Electrical Imports.—Official statistics have been published showing that during 1925 electrical goods to the value of about £310,000 were imported into Dairen, the second largest port of China. The 1924 imports were valued at approximately £360,000.

Unemployment. — The unemployment total stood at 1,594,200 on August 9th, as compared with 1,618,744 on August 2nd, and 1,269,480 on August 10th, 1925.

German Competition in Holland.—The complaints of Dutch firms concerning the severity of German competition in Holland appear to be fully justified by the figures which have been issued of the imports into that country. Last year, according to the Dutch official statistics, the value of the imports of cables amounted to 9,000,000 florins, of which cables valued at over 8,000,000 fl. were obtained from Germany. The total imports of generators, motors and transformers represented 5,739,000 fl., of which Germany supplied 3,701,000 fl., or an increase of 927,000 fl. over 1924. The second place is ascribed to England, which furnished machinery of the value of 734,000 fl. Germany also occupies the first place in the supply of radio, and telephone and telegraph apparatus. In the case of electrical apparatus and instruments, Germany sent to Holland goods to the value of 4,571,000 fl., out of the total imports of 5,695,000 fl. under this heading, while the share of England was only 396,000 fl. It is stated that a large part of the German manufactures forwarded to Holland is re-exported to the Dutch colonies.

Revival on the North-East Coast.—Our Darlington correspondent writes:—There are encouraging signs of trade revival on the North-East Coast, and the outlook appears to be much more favourable than has been the case for several years past. From Middlesbrough comes the report that the North-Eastern Railway Company proposes to carry out considerable extensions to its docks; that the Synthetic Ammonia and Nitrates Co., of Billingham, is to undertake the building of a new private dock on the north bank of the Tees; that the Rio Tinto Co. is preparing to install copper smelting works; and that Messrs. Swan, Hunter and Wigham Richardson project a new shipbuilding and repairing yard. It is also stated that Messrs. Dorman, Long & Co., Ltd., are restarting at their Redcar works three steel furnaces and a plate mill, and at their Port Clarence works another plate mill. It is reported from Stockton that there are hopes of the restarting of the extensive engine works of Messrs. Blair & Co., Ltd., which it had been feared were permanently closed. News from the Wear and Tyne, though not so definite, also indicates that a big revival is being prepared for. These reports appear to be well grounded, and the electrical trades are bound to benefit enormously. In connection with the new schemes being prepared, both at Middlesbrough and Stockton, considerable quantities of electrical apparatus will be required.

American Primary Battery Production. — *Commerce Reports* states that during the past four years (1922-25) the value of primary batteries produced in the United States was about $100,000,000. Of this total about 7 per cent. was exported. The most important customer for these goods was Argentina, which took 18.6 per cent. of the exports. Australia received 6.6 per cent. and Great Britain 3.8 per cent. Curves reproduced by our contemporary show graphically the very pronounced rise in consumption which occurs in the winter months.

Catalogues and Lists.—THE SIFAM ELECTRICAL INSTRUMENT CO., 95, Queen Victoria Street, E.C.—Two illustrated pamphlets dealing with instruments (voltmeters, &c.), for use in radio work. Priced.

MESSRS. PLENTY & SON, LTD., Eagle Iron Works, Newbury, Berks.—A well-illustrated brochure describing the "Plenty" stationary oil engine.

VENNER TIME SWITCHES, LTD., 45, Horseferry Road, S.W.1.—List No. 30, "Some Clock Notes," dealing with the mechanism embodied in "Venner" time switches; and List No. 32, describing the "Venner-Shotter" water-flow meter which is now being made by the company.

THE DRAYTON REGULATOR AND INSTRUMENT CO., LTD., West Drayton, Middlesex.—Leaflet No. 96, illustrating and describing the "Drayton" automatic boiler water-level controller.

MESSRS. FERRANTI, LTD., Hollinwood, Lancs.—Pamphlets Wa 401 and Wa 403, illustrating and describing the performance of the company's AF3 and AF4 audio-frequency transformers.

BRITISH INSULATED CABLES, LTD., Prescot, Lancs.—List No. P.202, containing particulars and prices of "Prescot" jointing compounds.

THE HART ACCUMULATOR CO., LTD., Marshgate Lane, Stratford, E.15.—Two showcards in colours, advertising "Hart" and "Enduro" batteries for radio work.

METROPOLITAN-VICKERS AUSTRALIA PTY., LTD., Auburn (N.S.W.) and South Melbourne (Vic.).—Leaflets Nos. 58 and 59, dealing respectively with heavy-current oil circuit-breakers and indoor isolating switches.

THE CHLORIDE ELECTRICAL STORAGE CO., LTD., Clifton Junction, near Manchester.—A well-illustrated brochure describing the construction and performance of "Exide-Ironclad" batteries for traction purposes.

THE GENERAL ACCESSORIES CO., LTD., 125, High Holborn, W.C.1.—A fully-illustrated catalogue of electrical accessories, including switch- and fuse-gear, plugs and sockets, &c.

MESSRS. A. H. HUNT, LTD., Tunstall Road, Croydon.—Leaflet No. 155a, advertising "Hellesen" radio and pocket lamp batteries; and Leaflet No. 170, describing the company's factory organisation.

AUTOVEYORS, LTD., 84, Victoria Street, S.W.1.—A price list of "Clix" plugs and sockets and terminals.

BATTERIES, LTD., Crabbs Cross, Redditch.—Illustrated and priced leaflet No. 9/26, descriptive of a new steel-plate "NIFE" accumulator for use in the high-voltage circuit of radio receiving sets.

THE WENHAM LIGHTING CORPORATION, LTD., 184, Gray's Inn Road, W.C.1.—An illustrated and priced pamphlet dealing with "Rex-Ray" shop-window reflectors.

THE EDISON SWAN ELECTRIC CO., LTD., 123-25, Queen Victoria Street, E.C.4.—A well-illustrated brochure dealing with correct lighting in the home, and containing illustrations and prices of various types of fittings. Also a blue print illustrating a range of dustproof lighting units.

MESSRS. SCOTT BROS. (KEIGHLEY), Albion Works, Keighley.—A stock list of new and used machine tools, &c., with a separate price sheet.

MESSRS. G. & J. WEIR, LTD., Cathcart, Glasgow.—Booklets dealing with monel metal and its uses; the "Weir" turbo-feed pump; and the "Weir" corrosion detector for boiler feed systems.

Mr. ALFRED H. HUGHES, Eckington Road, Coal Aston, near Sheffield.—An illustrated pamphlet advertising "Derenco" radio valves; priced.

THE WANDSWORTH ELECTRICAL MANUFACTURING CO., LTD., Ludgate Hill, Birmingham.—A booklet dealing with the company's tumbler switches, illustrated by reproductions of the series of advertisements which secured a prize in the first ELECTRICAL REVIEW advertisement competition.

New French Companies.—A new company has lately been formed in Paris (25, Rue de Courcelles) with a capital of one million francs and the title La Société des Transmission de l'Energie pour l'Industrie, to establish an electric power transmission line between the hydro-electric station of the Compagnie Vaudoise des Forces Motrices des Lacs de Joux et de l'Aere and various industrial works in the Bellegarde district.

Another company has recently been registered in Paris (6, Place de l'Opéra), with a capital of one million francs and the title La Société de l'Appareillage Magneto-Electriques Brevets Perissel, to manufacture electrical equipment for motor vehicles.

Irish Free State Electrical Imports.—The imports of electrical goods, excluding machinery, into the Irish Free State during June last, amounted to a value of £45,816, as compared with £24,309 in the corresponding month of last year. The imports for the first half of the current year are officially returned at £221,474, as against £159,144 in the corresponding period of 1925, an increase of £62,330.

Radio Exhibits at the Prague Autumn Fair.—The *Gazette de Prague* says that for two years the radio-telephone industry has been well represented at the Prague Fair and that this section is extending more and more as the Czecho-Slovak industry develops. In the radiophonic section of the Prague Autumn Fair, which will be held from August 29th to September 5th, more than 60 Czecho-Slovak, French, British and Italian radio firms will be represented.—*Reuter's Trade Service* (Prague).

Employment during July.—The *Ministry of Labour Gazette* states that employment in the engineering industry during July was still adversely affected by the coal dispute. The general proportion of unemployed was 15.8 per cent.; in the marine branch it was 27.2 per cent., while in the electrical engineering industry the proportion was 8.5 per cent. The last figure shows an improvement over that of the previous month —11.3 per cent., but it was above the July, 1925, figure, which was 6.0 per cent. In the electrical wiring and contracting industry there was also an improvement, the percentage of unemployed being 11.9 as compared with 15.5 in June, but this, too, was well above the July, 1925, level—8.7 per cent. There was a slight decrease in unemployment in the electric cable, wire and lamp manufacturing industries, *viz.*, from 7.9 to 7.7 per cent., comparing with 7.2 per cent. in July, 1925.

Australian Duties Deferred.—Included in a list of articles upon which the new duties under the Australian Customs Tariff are to come into force at a later date are valves for wireless telegraphy and telephony. In this case the duty will not operate until October 1st next.

Austrian Tariff Increases.—The *Board of Trade Journal* has published a list showing a number of increases in Austrian import duties which came into force on August 11th. Under the revised tariff the rates of duty on steam engines, steam and water turbines, internal-combustion engines, &c., not specifically mentioned elsewhere, are increased all round. Dynamos and electric motors are also affected.

New Italian Companies.—Among the new electrical concerns recently organised in Italy are the Società Construzioni Idrauliche e Meccaniche, Milan, capital 300,000 lire; La Società Elettrica Teramo, Rome, capital 2 million lire; La Società Servizi e Impianti Telefonici e Elettrici, Rome, capital 50,000 lire; La Società Apparecchi Luci Elettricia e Affini, Turin, capital 200,000 lire; La Compagnia Italiana Furnivie Elettriche, Milan, capital 20,000 lire; the Società Progetto, Direzione e Costruzione Impianti Idroelettrici, Milan, capital 2,000 lire; La Società Industrie Elettriche, Orvieto, capital 500,000 lire; La Società Neri per Imprese Elettriche, Parma, capital 300,000 lire; La Società Idroelettrica Marmore, Turin, capital 9,000,000 lire; La Società Credito Elettrico Nazionale, Milan, capital 60,000 lire; La Società Idroelettrica Valle Trompia, Bologna, capital 200,000 lire; La Società Elettrica Centro Lario, Milan, capital 600,000 lire; and La Società Idroelettrica Aieta, Praia d'Aieta (Cosenza), capital 225,000 lire.

Book Notices.—"Shakespeare Heroine Souvenir Book." London: Shakespeare Memorial Fund, c/o British Broadcasting Co., Ltd. Price, 2s. 4d., post free.

The Council of the Institution of Electrical Engineers has revised the "I.E.E. Regulations for the Electrical Equipment of Ships," and has authorised the publication of a second edition. Copies may be obtained from the Secretary of the Institution, or from Messrs. E. & F. N. Spon, Ltd., at the following prices: Bound in blue cloth, 3s. 8d. post free; bound in black American cloth, 2s. 8d. post free.

We have received a copy of the booklet which Messrs. A. Reyrolle & Co., Ltd., had prepared in anticipation of the proposed visit of inspection to their works during the summer meeting of the Institution of Electrical Engineers, which had, however, to be cancelled. It is a handsome 31-page production consisting mainly of views of different sections of the works and their products, with brief explanatory notes.

"The *Transactions* of the South African Institute of Electrical Engineers." Vol. XVII, Part 6, June, 1926. Price, 2s.

"Scientific Papers of the Institute of Physical and Chemical Research," Vol. 5, July, 1926. No. 67, "On the Hardness of Different Structure in Steel"; No. 68, "Effect of Electric Field on the Spectral Lines of Zinc and Cadmium."

Pitman's *Electrical Educator*, Part 25, which has just been issued, contains a short article on "Units and Standards of Electrical Measurement," by Prof. G. W. O. Howe, D.Sc., and a portrait of the author.

The Manchurian Market.—A recent note published by *Commerce Reports* indicates growing activity in Mukden, Manchuria, stimulated by railway construction. The demand for engineering materials from the district has been especially good, most of the business having been done with the Mukden Government arsenal and the railways. The demand for motor transport and electrical machinery has been noteworthy. The Chinese are coming to appreciate the advantages of using electric power. In addition to the increasing number of electric lighting plants being operated in Manchurian towns, a large business is now being done in motor-driven machinery for the preparation of cereals. This business promises to expand.

German Electrical Trust Rumours.—The Berlin house of Siemens has now issued a statement respecting recent reports of the intention to form a trust of electrical manufacturing works in Germany, to which reference was also made in the last issue of this journal. The firm states that it knows nothing of the matter, and that for months past it has not participated in negotiations or discussions either with regard to telephones and telegraphs or in respect of heavy electrical engineering.

For Sale.—Messrs. H. & R. L. Cobb (Daniel Smith, Oakley & Garrard) will sell by auction on September 9th and 10th, at the Isle of Grain Aerodrome, Port Victoria Station, machinery, &c., including generating sets, motors, electrical fittings, &c. Edinburgh Corporation Electricity Supply Department invites offers for 20 tons of clean scrap copper wire. Messrs. Fuller, Horsey, Sons & Cassell will sell by auction on September 14th, at the Baltic Exchange, E.C., the rolling stock and equipment of the Never-Stop Railway. (See our advertisement pages to-day.)

Key Industry Duties on Carbons.—The *Board of Trade Journal* for August 19th contained a notice confirming the continuance of the Key Industry Duty on certain goods for a period of 10 years from August 19th, 1926, with the following modification and addition: The rate charged upon imported arc-lamp carbons is to be 1s. per lb. instead of one-third *ad valorem*; and a duty of one-third *ad valorem* is imposed upon imported amorphous carbon electrodes, not including primary battery or arc-lamp carbons. The duty does not apply to goods produced within the Empire.

Scottish Electricians' Wage Claim.—At a meeting of members of the National Union of Corporation Workers employed in the Electricity Department of the Edinburgh Corporation, on August 18th, it was decided to claim wages equal to those paid in the London area. The weekly minimum in London is £3 11s. 6d., while that in Edinburgh is stated to be £2 10s. 11d.

Portuguese Tariff Changes.—As from August 9th a number of alterations in the Portuguese Customs Tariff were put into force. Among the articles affected are portable electric lamps, the import duty on which is raised to 0.20 escudo per kg. minimum and 0.60 escudo maximum. Similar rates are applied to tubes of paper, &c., for protecting electrical wires.

Canadian Electrical Imports.—A preliminary report upon Canadian external trade during the year ended March 31st last, shows a total increase of $130,000,000 in the imports. The importation of electrical apparatus increased by $1,727,000.

Catalogues Wanted.—MESSRS. PAGE ELECTRICAL, 152, Great Charles Street, Birmingham, ask for catalogues and prices of electrical equipment and accessories, mainly for export to the East.

MESSRS. LEONARD TOOMER & CO., 54, Lower Thames Street, E.C.3, ask for catalogues and factors' terms of electric lighting supplies and radio accessories.

The CELTIC ELECTRIC CO., 21, Wellington Quay, Dublin, asks for catalogues from manufacturers of radio and electrical goods. The firm is a wholesale supplier of goods to the Irish electrical trade.

A Guide to Official Statistics.—Government publications constitute the most important source of statistics in the United Kingdom, but this mass of information of the highest authority and practical value remained virtually inaccessible until the publication of the "Guide to Current Official Statistics," the 1925 volume of which has just been issued by the Permanent Consultative Committee on Official Statistics (Stationery Office, 1s. net). The guide not only directs the inquirer to all the publications containing statistics bearing on his subject, but also describes their mode of analysis, and the time and place to which they relate. The present volume, the fourth of the annual series, deals with all Government publications issued in 1925 and with a selection of those issued in 1926.

Lighting and Power Notes.

Ayrshire.—OIL FUEL.—Owing to the difficulty in obtaining suitable fuel the Ayrshire Electricity Board has found it necessary to adapt some of its existing boilers for the use of oil fuel, and announces that the existing coal clause, which is applicable to all energy used for power purposes, is now replaced by a fuel clause. The charges for power purposes are based on the average price of coal and oil fuel delivered at the power stations.

CHANGE-OVER.—The Ayrshire Electricity Board has announced its intention to alter the system and pressure of supply from 500 and 250 V, d.c., and a.c., single-phase, 50 cycles, 100 and 200 V, to a.c. three-phase, 50 cycles, 4-wire, 240 and 415 V.

Burnley.—YEAR'S WORKING.—The accounts of the Corporation electricity undertaking (engineer, Mr. J. E. Starkie) for the year ended March 31st last, show a total income of £90,432, as compared with £87,424 in 1924-25. The working expenditure was £48,288, as against £42,023, leaving a gross profit of £42,144 (£46,507). After meeting capital charges there was a net surplus of £15,829, as compared with £19,857 in the previous year. Of this amount £6,000 was transferred to depreciation and meters extension account, and the remainder to reserve. The sales of electrical energy increased from 8,223,508 to 9,673,843 kWh, and the maximum supply demanded from 3,900 to 4,800 kW. The average revenue obtained per kWh fell from 2.551d. to 2.243d

Continental.—Spain.—The Madrid correspondent of *The Times* reports that the Cabinet has approved a big hydro-electric scheme which will entail the harnessing of the waters of the River Douro. This question has been before the Spanish and Portuguese Governments for many years, but owing to certain differences regarding the rights of each country, it has not been possible to proceed with the work. A concession has now been granted to a concern known as the Portuguese Society of Electric Traction. The decree says that negotiations with Portugal are to be reopened within a period not exceeding six months, and that if no definite agreement is arrived at the concessionnaires will begin work with a view to harnessing the power over the international section. Several subsidiary schemes are connected with the central one. It is proposed also to furnish electricity for consumption abroad, as the amount of energy developed will permit this. The time required to complete the initial part of the scheme will be eight years.

France.—The new central power station at Vendin-le-Vieil of the Société des Mines de Lens, is equipped with six 3,000-V, 3,000-r.p.m. steam turbo-alternators, of 12,500 kVA capacity each. The plant was supplied by the Société Alsacienne de Constructions Mécaniques, of Belfort.

The Compagnie Parisienne de Distribution de l'Electricité, in conjunction with the municipal authorities, has a number of schemes of electrical development in progress. Two schemes which are now completed comprised the extension of the plants at the Saint Ouen and Issy-les-Moulineaux stations from 120,000 kW to 330,000 kW. Programmes 3 and 4, at present in hand, include the replacing of the old 10,000-kW generating sets with new ones of 12,000 kW, the frequency being at the same time changed from 41⅔ to 50, an alteration which will enable the distribution system to be linked up with a supply from hydro-electric plants, and the installation at the Saint Ouen station of three new 30/35,000-kW turbo-generators with the necessary boilers. The 5th programme, also in progress, provides for the conversion of a d.c. five-wire distribution area to a.c. The 6th, estimated to cost 144 million fr., provides for an increase of the transformer plant to deal with the enlarged generating capacity. The 7th programme will comprise an extension of the distribution system and the establishment of two new transformer stations to deal with electricity at 60,000 V. Finally, the 8th programme provides for an increase of the capacity at the Sud Ouest central station to 120,000 kW. The total cost of the eight programmes is estimated at 1,046 million fr.

Sweden.—The president of the Waterfalls Board, in an interview recently, stated that no further construction of Government-owned water-power stations was planned for the time being as with the completion of the newest ones—the Lilla Edet on the Goeta River, and the Norrforsen, on the Ume River—the present power requirements would be met.—*Reuter's Trade Service* (Stockholm).

Dumfries.—Loan Sanctioned.—The Town Council has received sanction to a loan of £5,500 for the installation of new hydro-electric plant at the "sub-station" at Maxwelltown.

Inverness.—Fringe Order.—The Town Council is applying for a Fringe Order authorising the supply of electricity in the Lower Drummond district and for permission to establish a boosting station, at a cost of £500. It is proposed to supply Ness Castle and other mansions in the district.

Irish Free State.—Liffey Tunnel.—Work on the construction of the tunnel under the River Liffey at Dublin has commenced. It will be a service tunnel of 7 ft. diameter, to carry cables and new arterial water mains of the Dublin Corporation. The completion of the tunnel, and installation of cables, &c., is expected in from nine to twelve months.

Limerick.—The proposal of the Corporation to augment the city electricity supply from the temporary power station at the site of the Shannon works at Ardnacrusha, was considered at the meeting of the Limerick Harbour Board last week. Mr. Grant, city electrical engineer, explained that it was proposed to transmit the energy by overhead lines across the River Shannon at Sarsfield bridge, and along the quays to Mount Kennet, and thence to the power station. The Board referred the proposal to a Committee to submit a report as to whether the scheme would interfere with shipping or jeopardise the property of the harbour.

Ennis (Co. Clare).—The Administrative Commissioner having recommended the erection of a generating station to provide an electricity supply for the town, the Free State Minister of Industry and Commerce has replied that as the Shannon hydro-electric scheme will soon be in operation such a station is unnecessary.

Leeds.—Increased Charges.—The *Yorkshire Post* reports that since the beginning of the coal strike the extra cost of fuel to the Corporation Electricity Department has been between £40,000 and £50,000, and the cost of fuel per kWh generated has risen from .2d. to .7d. The Electricity Committee has therefore recommended that the charges to all classes of consumer be increased by ¼d. per kWh during the quarter October 1st to December 31st.

Nottinghamshire.—Special Order.—The Derbyshire and Nottinghamshire Electric Power Co. has applied to the Electricity Commissioners for a Special Order authorising it to supply electricity in the rural districts of Leake, Newark and Southwell, parts of the rural districts of Bingham, Basford, Skegby, Stapleford, and Shardlow, and the urban district of Warsop.

Peterborough.—Year's Working.—The report on the working of the City Council's electricity undertaking (engineer, Mr. H. A. Nevill) for the year ended March 31st last, records a total income of £70,006, as compared with £53,877 in the preceding year. Working expenses amounted to £33,874, as against £26,717, leaving a gross profit of £36,132 (£27,160), to which was added a balance of £246 from the previous year, and a grant from the Unemployment Grants Committee of £2,441, making a total of £38,818. This was distributed as follows:—Loan charges, £30,896; capital outlay charged to revenue, £1,292; reserve fund (surplus for the year), £6,631. The capital expenditure during the year amounted to £26,317, the bulk of which was spent on mains and services. The sales of electrical energy amounted to 10,019,230 kWh, an increase of approximately 47 per cent., and the maximum supply demanded rose from 3,400 to 4,300 kW.

Price Reductions.—Reductions in the charges for electricity have been made or recommended in the following districts:—

Edinburgh.—Lighting: 3½d. per kWh, with discounts varying according to the quantity consumed. Power and heating: First 1,000 kWh per annum, 1.4d. per kWh; next 30,000 kWh, .8d.; above this amount, .7d. per kWh. Domestic heating, cooking, &c.: Where separate meters are used, 1d. per kWh for the first 100 kWh per term and ½d. per kWh thereafter; combined rate, ½d. per kWh for all consumption above the energy allocated for lighting.

Limerick.—Lighting and power: A reduction of 1d. per kWh.

Bexhill.—Lighting: From 6d. to 5½d. per kWh. Power: From 2d. to 1½d. per kWh.

Radcliffe.—Loans.—The Urban District Council has applied for sanction to loans of £1,500 for the purchase of electric cookers to be let out on hire, and £13,000 for mains and services for three years.

Rawtenstall.—Year's Working.—The report on the working of the Corporation electricity undertaking (engineer, Mr. C. L. E. Stewart) for the year ended March 31st last, shows a total income of £56,249 and working expenditure of £30,687, leaving a gross profit of £25,562, to which was added bank interest of £163, and a grant from the Unemployment Grants Committee of £275, making a total of £26,001. Capital charges absorbed £19,725, and there was a net profit of £6,276. The electrical energy sold amounted to 10,882,942 kWh, an increase of 1,205,108 kWh, and the average price obtained per kWh fell from 1.3d. to 1.2d.

Stirling.—Supply to the Castle.—The Town Council has agreed, after negotiations with the War Department, to terms on which a supply of electricity will be available for the Castle, a military depôt. The entire cost, £917, is being met by the Town Council. The estimated annual revenue is £300, and the War Department guarantees that sum for ten years.

Sunderland. — Loan. — The Corporation Electricity Committee is applying for sanction to the borrowing of £20,000 for mains.

Tunbridge Wells.—Electricity Extensions.—The borough electrical engineer has reported that it has become essential to carry out extensions at the boiler house, and has recommended that tenders be called for. The estimated cost is £31,000. The Town Council has adopted the recommendation.

United States.—Large New Station.—According to the *Electrical World*, on August 4th, the Cleveland Electric Illuminating Company's new Avon power station was formally inaugurated by Mr. C. F. Brush, who started up the first 35,000-kW turbine in this station, which will have an ultimate capacity of 300,000 kW. The station represents an eventual investment of more than $30,000,000. It is 23 miles west of Cleveland on Lake Erie. The addition of its initial equipment will raise the rating of the Cleveland Company to more than 375,000 kW, and when the plant is completed the company's total rating will be 600,000 kW. While h.p. connections have been made to carry electricity to distant parts of the State, it is expected that most of the energy will be taken locally through intensive development of Cleveland's iron, steel and other industries.

Worksop.—Electricity Charges.—The Council has confirmed the decision of the Electricity Committee to cancel as from October 1st reductions in the price of electricity from April 1st last, with the exception that the business tariff will remain at 1d. per kWh all the year round. The Committee recommended an increase in the price of electricity before the ratepayers had had the benefit of the reduction.

Tramway and Railway Notes.

Argentina.—Omnibus Competition.—Reference is made in the report for the past year of the Compagnie Générale des Tramways Electriques de Rosario regarding the competition of motor-'buses with the tramways in the city of Rosario. It is stated that the falling off in receipts is largely due to the competition of 'buses, which, however, is regarded as having reached its maximum limit. Complaint is also made that the 'bus companies are not subject to the same onerous regula-

tions as the tramways, and endeavours are being made to induce the authorities to place them on the same basis as regards local taxation. Plans have been prepared for the construction of about 24 miles of new electric tramway to serve parts of the suburbs of Rosario.

Continental.—GERMANY.—Two sections of the Berlin Suburban Railway have been completed, that between the Stettiner station and Bernau (15 miles), and that between the Stettiner station and Oranienburg (17½ miles), while work is now in hand on the electrification of the section between the Tegel station and Velten. The time for the journey between Berlin and Bernau has been reduced from 48 to 36 minutes.

SWITZERLAND.—The authorities of the Berne-Neuenberg railway are seeking a loan from the Swiss Government to enable them to proceed with the electrification of their system.

Falkirk. — TRAMWAY IMPROVEMENTS. — According to the *Electric Railway and Tramway Journal* the announcement is made by the Falkirk and District Tramways Co., Ltd., that the present open upper-deck tramway cars serving the Falkirk-Larbert area are to be replaced by single deck Pullman cars fitted with upholstered seats and capable of a speed of 30 m.p.h. The circular track of eight miles is being renewed at a cost of £20,000, and the estimated cost of the introduction of the new service is £50,000 in all.

Irish Free State.—THE DUBLIN-LUCAN ELECTRIC TRAMWAY AGREEMENT.—It was announced at a recent meeting of the Kingstown Urban District Council that under the recent agreement between the Dublin townships and the Dublin United (Electric) Tramways Company for the re-opening as an extension of the city system of the Lucan electric tramway, a sum of £18,925 was to be apportioned as road grants, and on payment of this the Councils consented to postpone their right of purchase of the tramway for a period of 30 years from June 30th, 1939, provided leave were given by the company to the Kingstown and Dalkey Urban District Councils to carry mains to supply electricity to adjacent consumers.

London.—MANSION HOUSE SUB-STATION.—Two 2,000-kW rotary converters are to be installed in the Mansion House Underground sub-station, and to provide room for one of these an existing 1,500-kW rotary converter is to be removed. The intention is to supply the eastern end of the Central London Railway from this sub-station and thus avoid addition to the size or number of sub-stations on that railway, which may be necessary to deal with future increases in the train services. The new equipment at Mansion House will also provide a margin to cope with further increases in the District Railway train services.

United States.—CHICAGO.—The *Electric Railway Journal* reports that a new subway plan for Chicago, calling for a tube under State Street from Chicago Avenue south to Twelfth Street and another under Jackson and Washington Boulevards from Michigan Avenue west to Clinton Street, is soon to be submitted to the local transportation committee of the City Council by the Citizens' Subway Commission. The plan differs from numerous other subway schemes that have been proposed for Chicago, particularly in its recommendations for a reduction in the number of streets in which bores should be made. Instead of an initial subway under State Street from North Avenue to 22nd Street, the recommendations of the commission will probably be for the construction of a much shorter line at a saving of millions of dollars. It is reported that the existing Washington and Van Buren Street tunnels, now used by surface cars in passing under the Chicago River, will be used in connection with a loop in Washington and Jackson Boulevards for east and west subways. This loop would be exclusively for street cars, while the north and south subway on State Street would be for the elevated lines alone. The commission has announced that it is also prepared to recommend a number of extensions of the elevated lines, action on which has long been delayed.

Telegraph and Telephone Notes.

Australia.—TELEGRAM TUBES.—Satisfactory progress is being made in Melbourne city with the construction of pneumatic tubes between the various branch post offices and the new central telegraph office, and the tubes should be operating when the new electric telegraph office opens for business about March, 1927. The tubes will carry telegrams handed in at the branch offices direct to the central telegraph office.

LIGHTHOUSE RADIO-TELEPHONY.—In conjunction with Amalgamated Wireless (Australasia), Ltd., the Commonwealth Lighthouse Service proposes to experiment with wireless-telephony as a means of breaking down the isolation of some of the more distant lighthouses. Owing to the high cost of land and submarine cables, many lighthouses have at present no means of communication with the mainland whatever. The first experiments are to be made at the lighthouses on Cliffy Island and Deal Island, in Bass Strait. A third station will be erected on Wilson's Promontory, and communication will be established through this station. The wave-length will probably be about 800 metres.

Germany.—THE TELEPHONE INDUSTRY.—The conversion of the telephone system to automatic working, which is being gradually effected throughout the country by the German postal authorities (at present the transition is being made or prepared for in about 20 towns) has led to a revival in sales in the telephone industry. Orders for new automatic apparatus are being received in satisfactory volume, although the generally depressed condition of industry still hinders the complete execution of the plans for transformation. The situation in the textile industry is regarded with a certain amount of anxiety, as this industry is one of the most important customers of the telephone industry.—*Reuter's Trade Service* (Essen).

Irish Free State.—AUTOMATIC TELEPHONY.—Automatic telephones will be in operation in Dublin by December next. The first step will be the changing over of the Ship Street relief exchange, and it is proposed to convert the Central Exchange also to automatic working, as well as the major exchanges on the outskirts of the city, such as Drumcondra, Rathmines, Ballsbridge, and Clontarf; in addition, a new exchange, called Merrion, will cover the area around Merrion Square; it is already acting as a relief exchange, and dealing with over one thousand lines. The automatic system will be used only for local calls. For trunk and junction calls the attention of an operator at the main exchange will be necessary.

Portugal.—RAILWAY INTERFERENCE.—The recent electrification of the railway between Lisbon and Cascais has caused some slight interference with the Eastern Telegraph Company's cable station at Carcavellos. It was discovered that there were some defects due to bad bonding, and on representations being made to the Government, the electric service was suspended until August 18th to permit the engineers to discover the cause of the interference. The cable service is, however, working, and no messages have been interrupted.—*Reuter* (Lisbon).

The Telephone Service.—TRUNK CALLS.—Inland trunk telephone statistics for the two past financial years show an increase for 1925-26 of 8,712,809 calls, or 11 per cent.; the total was 77,288,439. The number of trunk circuits in use was 13,075, an increase of 1,439, and the average number of trunk calls dealt with daily was 278,321, an increase of 28,179. During the year 224,187 calls were made to the Continent, an increase of 21,808, while 265,414 (54 per cent. of the both-ways traffic) came into this country from the Continent.

Radio Notes.

Australia.—LICENCES.—Broadcast radio receiving licences issued in June numbered in: New South Wales, 2,582; Victoria, 8,525; Queensland, 1,742; South Australia, 969; Western Australia, 318; Tasmania, 109; the total for the Commonwealth being 14,245. The number of licences held in Australia at the end of June was 125,047, of which 63,494 were held in Victoria; those held in other States were: New South Wales, 36,292; Queensland, 8,100; South Australia, 12,105; Western Australia, 3,886; Tasmania, 1,170. The totals at the end of June, 1925, were: New South Wales, 35,209; Victoria, 20,491; Queensland, 1,328; South Australia, 3,399; Western Australia, 3 621; Tasmania, 588; the total for the Commonwealth being 64,636. At present there are 3.8 licences in Victoria per 100 of the population, the Commonwealth average being 2.1. The figures for other States are: New South Wales, 1.6; Queensland, .9; South Australia, 2.2; Western Australia, .1; Tasmania, .5.

Standard Transmissions.—AUGMENTED SERVICE.—On the recommendation of the Radio Research Board of the Department of Scientific and Industrial Research, waves of accurately known frequency have been transmitted during the past three years from the National Physical Laboratory (5 HW) in order to provide means of checking the calibration of wave-meters and other apparatus. In order to increase the usefulness of this service, the present transmissions of eight waves covering a range of from 360 to 60 kilocycles per second (833 to 5,000 metres wave-length) between the hours of 15.00 and 16.00 G.m.t. on alternate Tuesdays are to be greatly augmented. The new transmissions will commence on September 7th, and will include 16 waves, which will be transmitted in two sections, each once per calendar month between the above-mentioned hours. On the first Tuesday in each month the short-wave (960 to 260 kilocycles per second) programme will be radiated, and on the third Tuesday the long-wave (200 to 30 kilocycles per second) programme will be sent out.

Sweden.—NEW STATION.—The new broadcasting station owned by the Radio Club of Helsingborg, which has commenced operation with a wave length of 235 metres, will serve as a link for relaying Stockholm and Malmo programmes. Sales of radio materials have been good during the winter months, says *Commerce Reports*, especially large sets which permit reception from European stations. An increased number of radio licences was issued during the first quarter of 1926.

Contracts Open and Closed.

(The date given in parentheses at the end of the paragraph indicates the issue of the "Electrical Review" in which the "Official Notice" appeared in our advertisement pages.)

Open.

Australia.—MELBOURNE.—October 20th. Victorian Government Railways. Rail motor equipment. (A.X. 3449.)*
September 14th. Postmaster-General's Department. Telephonists' telephones and hand sets.
September 21st. Switchboard keys and parts. (B.X. 2669.)*
October 5th. Switchboard cords. (B.X. 2747.)*
October 12th. Automatic exchange equipment.
October 26th. Telephone plugs and sleeves. (B.X. 2799.)*
SYDNEY.—September 20th. Municipal Council. H.p. d.c. apparatus for cable testing.
October 18th. Two 100-ton electrical overhead travelling cranes. (A.X. 3467.)*
November 1st. Boiler feed pumps for Bunnerong power station. (A.X. 3470.)*

Belgium.—GHENT.—September 18th. Municipal Authorities. Steam turbine and alternator at the local central station. Particulars from Service de l'Electricité, Hotel de Ville.
September 15th. Post and Telegraph Authorities, La Salle Madeleine, Brussels. Supply and laying of telephone cables at Bascoup, Genval and Ottignies. Particulars (Cahier des Charges Special No. 3-202) for 9 francs.

Cheadle and Gatley.—August 31st. Electricity Department. One 125-kVA transformer (Contract No. 25), extra-high-pressure switchgear (Contract No. 29). Specifications and forms of tender of Mr. R. W. Willis, electrical engineer and manager, 37, High Street, Cheadle.

Chester.—September 13th. Electric wiring of Chester Castle. (See this issue.)

Coventry. — September 3rd. Electricity Department. Buildings, foundations, and subways, two 15,000-kW turbo-alternators, condensing plant and auxiliaries, water-tube boilers, complete with accessories, coal- and ash-handling plant, switchgear, pipework, crane, and cooling towers. (July 23rd.)

Croydon. — September 6th. Electricity Department. Two 50,000-lb. water-tube boilers and equipment. (July 30th.)

Doncaster.—August 31st. Electricity Department. One 6,000-kW, 3-phase turbo-generator, with condensing plant. (August 13th.)

Dublin.—Department of Posts and Telegraphs.
August 30th. Automatic and C.B. telephones.
August 31st. Electric light fittings (various).
September 6th. Paper core twin cable (various sizes).
September 7th. Enamelled and cotton core cable (various sizes).
—*Irish Electrician.*

Electricity Department. Supply for one year of single-phase and 3-phase meters, including slot meters. City Electrical Engineer, Fleet Street, Dublin.

Dundee.—August 28th. Town Council. Electric lighting and heating work at Public Health Institute. Particulars from the Town Clerk.

Dunoon.—August 31st. District Cottage Hospital. Electric lighting, &c., at new operating theatre, and other extensions. Schedules from Messrs. John Burnet, Son and Dick, architects, 239, St. Vincent Street, Glasgow.

Edinburgh.—August 30th. Association for the Provision of Hostels for Women Students. Electric lighting and power installations at two hostels. Schedules from Mr. Frank Wood, architect, 6a, George Street, Edinburgh.
Governors of George Heriot's Trust. Electric and heating installations in connection with the new mining laboratories. Specifications, &c., from Mr. John Anderson, superintendent of works, 20, York Place, Edinburgh.
September 10th. H.M. Commissioners of Works. Electric wiring (in steel conduit) at Edinburgh Castle. Architect, H.M. Office of Works, 122, George Street, Edinburgh.

Grays. — September 6th. Grays Thurrock Electricity Department.. One 250-kW rotary converter, with transformer, h. and l.p. switchgear, one 500-kW motor-converter, with h. and l.p. switchgear. (August 20th.)

Grimsby.—September 4th. Electricity Department. Ducts and l.p. feeder cables. (August 20th.)

Halifax.—September 18th. Housing Committee. Electrician's work (wiring) required in connection with the erection of 58 houses, Nursery Lane (Section No. 4, Ovenden Cross). Specifications from Borough Engineer, Crossley Street, Halifax.

Hamilton.—Town Council. Electric lighting of new slaughter house. The Town Clerk.

India.—September 10th. India Store Department. Switchgear and auxiliary plant in connection with the G.I.P. Railway electrification. Forms of tender (20s.) from the above.
August 31st. 12,000 electric lamps. (August 20th.)
September 6th. Two 40-kW 240/480-V, 3-wire oil engine d.c. generating sets. (B.X. 2782.)*
September 7th. One 5-ton electric jib crane. Forms of tender (5s.) from the Department.
September 10th. One 300-kW d.c. steam set, with boiler, condenser, cooling tower and auxiliaries, and switchboard, &c., complete for Peshawur Cantonment power station. (See this issue.)

Liverpool.—August 31st. Corporation. Supply and installation of a closed-circuit, code-signalling street fire-alarm and telephone system. (July 30th.)

London.—LONDON COUNTY COUNCIL.—September 13th. Three water-tube boilers, with auxiliaries. (August 13th.)
August 30th. Electric goods lift and electric service lift for the Hackney Institute. (August 13th.)
September 6th. Electrical installation at the Hackney Institute. (August 20th.)
ST. MARYLEBONE.—September 13th. Works and Highways Department. Electric overhead runway for house refuse. Specifications from the Borough Engineer.
HOLBORN.—September 8th. Board of Guardians. Six months' supply of electrical fittings. Forms of tender from Mr. C. J. Cross, Clerk to the Guardians, 53, Clerkenwell Road, E.C.
WESTMINSTER.—September 1st. Board of Guardians. Electric lamps and fittings. Forms of tender from Mr. W. J. Lickley, Clerk to the Guardians, Princess Row, S.W.1.
STEPNEY.—September 2nd. Board of Guardians. Six months' supply of electrical fittings. Mr. S. McClelland, clerk to the Guardians, Raine Street, Old Gravel Lane, E.1.

New Zealand.—CHRISTCHURCH.—October 19th. Christchurch Drainage Board. Three sets of electric centrifugal pumping plant. (A.X. 3215.)*
WELLINGTON.—September 28th. Public Works Department. Three electrically-driven low-lift pumps, with control apparatus, for the Taleri drainage. (A.X. 3274.)*
November 2nd. Electric generators and turbines. (B.X. 2622); indoor control gear and switchgear. (B.X. 2675); 110,000-V transformer for Waikaremoana power scheme. (B.X. 2744.)*
September 7th. Synchronous condenser for the Arapuni electric power scheme. (B.X. 2654.)*
October 5th. One four-motor overhead travelling crane and runway. (AX. 3517.)*
November 23rd. Lightning arresters and transformers. (B.X. 2792.)*
DUNEDIN.—September 8th. City Council. One reaction waterwheel, with governor and valves, &c., one 3,000-kW generator, four 1,000-kW transformers, switchboards, oil-break switches, voltmeters, &c. (B.X. 2676.)*
NEW PLYMOUTH.—October 16th. Harbour Board. One 30-cwt. portal electric jib crane, &c. (A.X. 3458.)*
AUCKLAND.—October 4th. Electric Power Board. Pole oil switches. (B.X. 2795.)*
October 11th. Ironclad switchgear and single-phase transformers. (B.X. 2793.)*

Sevenoaks.—September 1st. Urban District Council. Supply and installation of an electrically-driven siren at the fire station. (July 30th.)

South Africa.—JOHANNESBURG.—September 18th. Town Council. 6,600-V, truck-type, ironclad switchgear. (B.X. 2767),* underwriters' wire. (B.X. 2766.)*
September 23rd. Switchboard type overload relays. (B.X. 2809.)*
CAPE TOWN.—September 15th. Municipal Council. Cables. (B.X. 2802.)*

Stoke-on-Trent.—September 7th. Electricity Department. One 10,000-kW turbo-alternator and condensing plant. One natural-draught cooling tower. Ironclad l.p., 3-phase switchgear. (July 23rd.)

Tunbridge Wells.—September 11th. Electricity Committee. Two water-tube boilers, superheaters, economisers, mechanical stokers, forced- and induced-draught plant, steel stack, overhead coal bunkers, coal elevator and conveyor, and a truck tippler. (August 13th.)

Warrington.—September 6th. Electricity and Tramways Committee. 12 months' supply of earthenware conduits. (August 20th.)

*Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

Closed.

Australia.—SYDNEY.—City Council. Accepted :—
Parkinson motor and Bruce Peebles generator for storage battery, control panels and battery-charging sets for Zetland sub-station (spec. 1,031) (£1,438).—Tudor Accumulator Co., Ltd.
MELBOURNE.—State Electricity Commission. Accepted :—
Lightning arresters (£778).—Aust. Westinghouse Electric Co., Ltd.
—*Tenders.*

Dublin.—The following contracts were placed by the Controller of Stores (Posts and Telegraphs), from June 23rd-July 22nd :—

Automatic telephone equipment.—Standard Telephones & Cables, Ltd.
Telephone bell sets.—International Electric Co., Ltd.; Siemens Bros. & Co.; Peel Conner Telephone Works.
Dry cells.—Hayward Co.
Porous and dry cells.—General Electric Co., Ltd.; Siemens Bros & Co., Ltd.
Telephone coils.—Standard Telephones & Cables, Ltd.
Telephone indicators.—Telephone Manufacturing Co., Ltd.
Telephone jacks.—Phœnix Telephone and Electric Works, Ltd.; Ericsson Telephones, Ltd.; International Electric Co., Ltd.; Telephone Manufacturing Co., Ltd.
Telephone relays.—Standard Telephones & Cables, Ltd.
Copper staples.—R. Johnson & Nephew, Ltd.
Connection strips.—Telephone Manufacturing Co., Ltd.
Switchboards.—Ericsson Telephones, Ltd.; Telephone Manufacturing Co., Ltd.
Tumbler switches.—Cable Accessories Co., Ltd.

—*Irish Electrician.*

Government Contracts.—The following Government contracts were placed during July, 1926 :—

ADMIRALTY CONTRACT AND PURCHASE DEPARTMENT.

E.h.p. feeder cable.—General Electric Co., Ltd.
Electric cable and wires.—General Electric Co., Ltd.; Johnson & Phillips, Ltd.; Enfield Cable Works, Ltd.; W. T. Glover & Co., Ltd.; Anchor Cable Co., Ltd.; Siemens Bros. & Co., Ltd.; Hooper's Telegraph and I.R. Works, Ltd.
Electric overhead travelling cranes.—Vaughan Crane Co., Ltd.
Electrodes.—Alloy Welding Processes, Ltd.
Crucible furnaces.—Morgan Crucible Co., Ltd.
Motor alternators and control gear.—Electric Construction Co., Ltd.
Motor booster set.—British Thomson-Houston Co., Ltd.
Water-tight switches.—General Electric Co., Ltd.; W. McGeoch & Co., Ltd.
Electric lamps.—Metro-Vick Supplies, Ltd.

WAR OFFICE.

Dry batteries.—Ever Ready Co. (Gt. Britain), Ltd.; Edison Swan Electric Co., Ltd.
Secondary batteries.—Chloride Electrical Storage Co., Ltd.
Dry and inert cells.—General Electric Co., Ltd.; Siemens Bros. & Co., Ltd.
Electric fans.—Cable Accessories Co., Ltd.
Generators.—Newton Bros., Ltd.

AIR MINISTRY.

Ignition accessories.—Pyne Mfg. Co., Ltd.
Accumulators.—Chloride Electrical Storage Co., Ltd.; Edison Swan Electric Co., Ltd.; Peto & Radford.
Internal wiring (Bicester).—Malcolm & Allen, Ltd.; (Tangmere), T. Clarke and Co., Ltd.
Magneto spares.—M. L. Magneto Syndicate, Ltd.

POST OFFICE.

Telephone apparatus.—Ericsson Telephones, Ltd.; International Electric Co., Ltd.; Phœnix Telephone & Electric Works, Ltd.; Plessey Co. (1925), Ltd.; Siemens Bros. & Co., Ltd.; Telephone Mfg. Co., Ltd.
Testing, protective and miscellaneous apparatus.—Ericsson Telephones, Ltd.; Walter Jones & Co.; Phœnix Telephone & Electric Works, Ltd.; Power Equipment Co., Ltd.; Standard Telephones & Cables, Ltd.; M. W. Woods.
Wireless apparatus.—Dubilier Condenser Co. (1925), Ltd.; Marconi International Marine Communication Co., Ltd
Battery stores.—C. A. Vandervell & Co., Ltd
Telephone cabinets.—Siemens Bros. & Co., Ltd.
Cable (various).—British Insulated Cables, Ltd.; Connolly's (Blackley), Ltd.; W. T. Henley's Telegraph Works Co., Ltd.; Siemens Bros. and Co., Ltd.; Union Cable Co., Ltd.
Lamp caps.—B. W. Johnson.
Joint box castings.—Britannia Lathe and Oil Engine Co., Ltd.
Telephone cords.—International Electric Co., Ltd.; Phœnix Telephone and Electric Works, Ltd.; Siemens Bros. & Co., Ltd.; Standard Telephones and Cables, Ltd.; Telephone Mfg. Co., Ltd.
Electric lamps.—Edison Swan Electric Co., Ltd.; General Electric Co., Ltd.
Insulator rings.—Avon India Rubber Co., Ltd
Lead sleeves.—G. Farmiloe & Sons, Ltd.
Covered wires.—International Electric Co., Ltd.; Macintosh Cable Co., Ltd.
Leclanché zinc rods.—Eyre Smelting Co., Ltd.; Siemens Bros. & Co., Ltd.
Manufacture, supply, drawing-in and jointing cable.—Sheffield-Worksop: British Insulated Cables, Ltd. Tavistock-Truro, Polmarkyn-Liskeard: Pirelli General Cable Works, Ltd. Truro-Penzance: W. T. Henley's Telegraph Works Co., Ltd.
Telephone exchange equipment.—Watts, Watts & Co., Ltd. (Cardiff); Multi Office, Liverpool Co-operative Society, Ltd.: Relay Automatic Telephone Co., Ltd. Maryhill (Glasgow): Automatic Telephone Mfg. Co., Ltd.; sub-contractors, Crompton & Co., Ltd., for machines, Alton Battery Co., Ltd., for batteries Torquay: Automatic Telephone Mfg. Co., Ltd. Halifax: Standard Telephones & Cables, Ltd.; sub-contractors, Electric Construction Co., Ltd., for charging machines, Crompton & Co., Ltd., for ringing machines, D.P. Battery Co., Ltd., for batteries. Sloane: Standard Telephones & Cables, Ltd.; sub-contractors, Newton Bros. (Derby), Ltd., for charging machines and control gear, Crompton & Co., Ltd., for ringing machines, D.P. Battery Co., Ltd., for batteries. Barnet: General Electric Co., Ltd.; sub-contractors, Crompton & Co., Ltd., for machines. Batley (Yorks.): General Electric Co., Ltd.; sub-contractors, Crompton & Co., Ltd., for machines, Tudor Accumulator Co., Ltd., for batteries. Birmingham (South), Enfield: General Electric Co., Ltd.
4-wire telephone repeater station equipment.—Newcastle-on-Tyne, Catterick: Standard Telephones & Cables, Ltd.
Telephone repeater station power plant.—Canterbury: General Electric Co., Ltd.; sub-contractors, Premier Accumulator Co. (1921), Ltd., for batteries, Ruston & Hornsby, Ltd., for engines.
Modifications and additions to switchgear, Rugby wireless station.—British Thomson-Houston Co., Ltd.
Two receivers, wireless station, Burnham (Som.).—Marconi's Wireless Telegraph Co., Ltd.

CROWN AGENTS FOR THE COLONIES.

Cable, &c.—Enfield Cable Works, Ltd.; British Insulated Cables, Ltd.
Electric transformers.—English Electric Co., Ltd.
Generator.—Ruston & Hornsby, Ltd.
Meters.—Ferranti, Ltd.
Coal-crushing plant.—Babcock & Wilcox, Ltd.
Telegraph ironwork, &c.—Bullers, Ltd.; Siemens Bros. & Co., Ltd.
Telephone switchboard and spares.—British L. M. Ericsson Mfg. Co., Ltd.
Track control apparatus.—Standard Telephones & Cables, Ltd.

H.M. OFFICE OF WORKS.

Wiring Science Museum.—Tredegars (1925), Ltd.

Gravesend.—Electricity Committee. Recommended:—

Switchgear alterations for automatic operation (£960).—Bertram Thomas.
Oil purifier (£99).—De Laval, Chadburn Co., Ltd.

London.—Great Western Railway. Accepted:—

Four electric trolleys for Cardiff.—Electromobile, Ltd., and Ransomes, Sims and Jefferies, Ltd.
Two electrically-driven pressure pumps for Reading.—Fielding & Platt, Ltd.

Newmilns.—Town Council. Accepted:—

Wiring 24 houses for electric light (£114).—James Laird & Co.

Newport (Mon.).—Electricity Committee. Accepted:—

Pumping plant, screening plant, and auxiliary plant (£10,973).—Worthington-Simpson, Ltd.
Switchgear (£1,126).—G. Ellison.

New Zealand.—The Auckland City Council has received tenders for 600 tons of steel rails, one from the United States Steel Rails Co. for £6,569, and four British tenders ranging from £8,544 to £9,097. Three of the British tenders are subject to the termination of the British coal strike. The fourth tender, from the Cargo Fleet Iron Co., Ltd., is without that condition. The Tramway Committee recommended the acceptance of the American tender, but the Council decided to accept a British tender provided that delivery was made before the end of the current year.—*Reuter* (Wellington).

Norfolk.—Standing Joint Committee. Accepted:—

Electric lighting installation at police station, Norwich (£156).—C. Gates, Ltd.

South Africa.—CAPE TOWN.—Electricity Committee. Recommended :—

Jointing work (£600).—W. T. Henley's Telegraph Works Co., Ltd.
Centrifugal pump (£126).—Griffin Engineering Co.
Two 1,000-kVA oil-cooled transformers (£1,560).—English Electric Co., Ltd.
200 200-watt 220-volt Goliath screw gasfilled lamps, and 1,000 500-watt lamps (£472).—Auto Electric Supply (Cape), Ltd.

Forthcoming Events.

International Exhibition for Navigation, Hydraulic Engineering and Water-Power Development.—At Basle. August 31st to September 8th.
National Radio Exhibition.—At Olympia, W. September 4th-18th.
Universal Smoke Abatement Exhibition.—At Bingley Hall, Birmingham. September 6th to 18th.

The "Electrical Review" Service Department.

We have a request for any data relating to MORRIS-HAWKINS dynamos.

Notes.

Midland Electrical Engineers' Ball.—It has been decided to hold the Midland Electrical Engineers' Ball this season, at the Grosvenor Suite, Grand Hotel, Birmingham, on Friday, November 19th. Mr. R. A. Chattock is president, and Messrs. W. H. Heaton (General Electric Co., Ltd., Witton) and W. Y. Anderson, 14, Dale End, Birmingham, are joint honorary secretaries. Tickets are one guinea each, and may be obtained from any of the above-mentioned gentlemen.

Electric Trolley 'Buses in France.—Increasing attention is being devoted in France to the advantage and economy of the railless trolley type of electric 'bus for public service, it having been demonstrated that with a cheap supply of electric power such lines can be run more economically than petrol 'buses, at the present high cost of the necessary liquid motor spirit. Two such lines are now in operation in the Department of Gard, both running between the towns of Nimes and Pont du Gard, but following different routes: One line is 14 miles in length and serves the little towns of Bezonces and Lafoux, while the other is 23 miles in length and passes through Jonquières, Comps, and Montfrin. Each 'bus is driven by two 20-h.p. electric motors. Accommodation for 27 passengers is provided, and also for 10 cwt. of luggage; some of the vehicles are also run with a trailer for goods transport. The average speed of the 'buses, each of which covers a distance of about 150 miles per day, is 20 m.p.h., reduced to 16½ m.p.h. in the case of the combined passenger and goods carrying outfits.

Large French Motors.—In the annual report of the Société Française pour l'Exploitation des Procédés Thomson-Houston it is stated that during the past year the company completed two twin electric motors of 30,000 h.p. for the operation of steel rolling mills at the works of the Société des Acieries de Denain et Anzin. The motors are stated to be the largest so far constructed in France.

Turbine for Steam Pressure Conversion.—A 6,000-kW steam turbine, designed for use initially with steam at 165 lb. per sq. in. and 400 deg. F., and having provision for easy reconstruction for operation on steam at 350 lb. and 700 deg. F., is, according to *Power*, to be installed by the Trinidad Electric Transmission, Railway and Gas Co., which supplies power to the Southern Colorado coal mines. The turbine is to be installed in the Walsenburg station, where the operating

steam pressures and temperatures will, at a later date, be brought to higher levels. Provision will be made for steam extraction from two stages for feed-water heating. The machine has been designed by the General Electric Co. with all the h.p. parts suitable for the maximum steam temperature and pressure. The castings and shafts are designed for 14 stages, but for the initial l.p. operation only nine wheels will be installed, and the first stage nozzles and buckets will be suitable for the low pressure. The five additional wheels, together with h.p. nozzles, will be shipped with the turbine, so that the plant can be converted when required without delay.

Educational.—The Polytechnic, Regent Street, W.—Electrical Engineering Department. The 1926-27 Session commences on Monday, September 27th, enrolments from September 15th to September 24th. Prospectus and full particulars can be obtained from the Director of Education. (See our advertisement pages to-day.)

East London College (University of London).—The 1926-27 session in Art, Science and Engineering commences on September 27th. Prospectus and full particulars can be obtained from the Registrar, Mr. E. J. Wignall, at the College, Mile End Road, E.1.

Appointments Vacant.—Electrical engineer, for the Gainsborough Urban District Council; station superintendent, for Portobello (Edinburgh) generating station (£569); engineer, for the Electrical Department, Buildings and Roads Branch of the Government of the Punjab; clerk of works (£175), for the Guildford Corporation Electricity Department. (See our advertisement pages to-day.)

An Electrical Veteran.—The *Electrical World* reports that the new Avon station of the Cleveland Electric Illuminating Co. was inaugurated on August 4th. The first generator was started up by Mr. Charles F. Brush, who invented the Brush electric arc lamp 48 years ago.

Permanent Paint for Iron.—The annual loss to the world due to the rusting of iron runs into millions of pounds, and the problem of its prevention is being studied by scientists in all civilised countries. A remarkable discovery is now announced from Switzerland. Dr. A. V. Blom, of Berne, has made a new lead paint which affords complete and permanent protection to iron. This paint is of a very special character; it is made by melting lead in an electric furnace and blowing through it air and certain reducing gases, so that a dross or scale is produced which consists of colloidal or extremely finely divided lead dispersed in yellow lead oxide. When it is powdered and mixed with a specially prepared linseed oil, and applied to an iron surface, very minute particles of lead separate out and gradually penetrate into the surface of the iron. The presence of the lead in the treated iron has been proved by photomicrographs and by chemical analysis. Iron objects painted with this new pigment have not shown any signs of rusting after prolonged exposure, or after being heated in steam. This discovery may lead to extremely important developments.—*Science News-Letter.*

Electricity in the Slate Industry.—With reference to the article under the above heading in our last issue, we are asked to state that the battery vehicles referred to are equipped with "Kathanode" batteries supplied by the D.P. Battery Co., Ltd.

Trade Recovery.—In a long letter to *The Times* of August 21st, Mr. W. Graham, M.P., draws attention to the mass of valuable information which is at the disposal of British manufacturers and trade unions, but which has been neglected. First he cites the two reports of the Balfour Committee in 1924, surveying oversea markets and industrial relations, which analyse the shrinkage in the real volume of world trade, the falling-off in the volume of our exports, and the effect of local manufacture in displacing British goods. There is in these reports a mass of information in respect of the finance, resources, trade, and commercial policy of each country, as well as data regarding population and wages, and the conditions of labour. Properly utilised, he says, they should produce results worth many scores of millions.

Again, the reports of the Department of Overseas Trade on the economic position of our leading competitors and other countries are worthy of study. The latest issue deals with finance, industry, and commerce in the United States, and shows that 40 per cent. of American exports are absorbed by the British Empire. The United States produces 40 per cent. of the world's coal output, and is gaining ground in markets which formerly bought British coal. The report states that the U.S. market for all kinds of high-class British goods is capable of expansion; it offers good openings for the textile industry and a number of the smaller trades, and vast areas in the United States are practically unexplored, so far as British goods are concerned. Moreover, American investments in Canadian, South American, and Central American industrial enterprises have laid the foundation for an expanding trade with those countries in the immediate future.

Some particulars are given regarding the assistance afforded to agriculture by the United States Government and banks, which could be related to the work of our Empire Marketing Board, for which £1,000,000 a year has been set aside, and it is urged that a broad-minded study of American labour policy would contribute to British industrial recovery. If the representative organisations of employers and employed had devoted a tenth of the time spent in strife to such a question as "simplification" (the elimination of numerous unnecessary sizes, types, styles, and patterns of products) great reductions in manufacturing costs could have been effected. Last, Mr. Graham says that British industry has much to learn from an analysis of the economic conditions in countries immediately exposed to the ravages of war, such as Belgium, of whose circumstances the Department of Overseas Trade has given an able review. There, material reconstruction has been practically completed, and the country's competitive power in the world's markets has been increased by co-operation, extended electricity supply, and commercial organisation. "Let employers and trade unions now resolve together to make the best use of a mass of valuable information offered them from every corner of the globe."

The "World's Greatest Light Spectacle." — At the "Philadelphia Sesqui-centennial" more lavish use has been made of lighting to produce the desired effects than at any previous affair of this kind. The outstanding feature is the luminous Liberty Bell at the Plaza, designed by Mr. D. W. Atwater, of the Westinghouse Lamp Company. Towering 80 ft. above the sidewalk, the tremendous replica of the historic bell contains over 26,000 15-W lamps in amber, ivory, and rose colourings. The structure contains eighty tons of steel, and rests on a foundation 30 ft. deep, built of wooden piling and concrete capping..

The Tower of Light, stretching far above the other Exposition buildings, when illuminated at night, is visible from all parts of the city as a lofty silver shaft shedding brilliant light. The tower, which is 200 ft. high, is in the centre of the Exposition. A 62-in. Sperry searchlight, the largest ever built, is mounted on top of the tower, and is used to sweep the Exposition grounds and prominent buildings in Philadelphia.

Twenty-four immense searchlights with a combined intensity of 10,800,000,000 candle-power are in the Exposition grounds, and form the greatest concentration of light ever seen in one spot in the history of the world. These searchlights are placed at intervals along both sides of the Exposition grounds, and are equipped with colour screens to form fantastic light effects. One of the many unique searchlight effects is an immense coloured aurora.

Ornamental standards and floodlights illuminate the Grand Court and produce an effect never before attempted. The towers of the Exhibition palaces are brought out in a pleasing blaze of colour and contrast. The Gladway, which adjoins the Grand Court on the west, is illuminated by myriads of lights of various magnitudes. The lagoons are swept by varicoloured floods of light.—*Journal of the Franklin Institute.*

Smoke Abatement Exhibition.—On September 6th a "Universal Smoke Abatement Exhibition" will be opened at the Bingley Hall, Birmingham, under the auspices of the Smoke Abatement League of Great Britain, and will remain open till September 18th. The occasion gains interest from the fact that a Smoke Abatement Bill is being carried through Parliament by the Government. Demonstrations will be given of new methods for preventing the emission of smoke from chimneys, and a large model industrial boiler-house will be shown, in the equipment of which twenty leading manufacturing firms have co-operated; this exhibit, occupying an area of 100 by 60 feet, has been planned to give a working demonstration of the most approved methods of securing maximum power at minimum cost, and with the least possible waste in the form of smoke. Other important exhibits in the Industrial Section will show the latest improvements in the application of gas, electricity, and oil for power purposes, and there will be many demonstrations of new devices and apparatus in connection with heat production generally.

There will be on view for the first time an electric furnace for hardening and annealing pen nibs, of which Birmingham provides three-quarters of the world's supply. This is the latest development in pen manufacture, and supersedes the open-hearth process hitherto employed. Kilning china with electricity is a new process of special interest to the Potteries, London, and other centres. The Domestic Section is on a similarly extensive scale. In this section will be shown the most modern appliances for lighting, heating, cooking, hot-water supply and ventilation. The address of the Exhibition Director is 207, Daimler House, Paradise Street, Birmingham.

Electrical Trades Benevolent Institution.—The annual festival dinner of this Institution will be held at the Trocadero Restaurant, London, on Wednesday, November 17th, 1926, at 7.30 p.m. Sir Hugo Hirst, Bart., has kindly consented to preside, and it is to be hoped that the many friends and supporters of this excellent organisation will turn up at the dinner in large numbers.

Electrolytic Disinfectant Fluid.—The report for 1925 of Dr. F. W. Alexander, Medical Officer of Health to the Borough of Poplar, states that 72,165 gallons of electrolytic disinfectant fluid were manufactured during 1924 and broken down to 144,330 gallons for distribution. The total cost of materials and electricity was £279, of which £134 was for electrical energy. Since the installation of the plant, a period of 20 years, 891,864 gallons of fluid have been manufactured, at a cost of £1,417 for electricity and of £1,720 for materials.

Combining Business and Pleasure.—The *Electrical World* says that in the smaller towns served by the Northern States Power Company, where there is a community spirit, very effective results have been obtained in developing a range-buying desire by combination entertainments and demon-

strations conducted by young lady representatives of the company. They arrange for the use of some hall, frequently securing it at no charge whatever because of the friendly relations which this company, through all its representatives, has developed. Some entertainment or vaudeville sketch is presented in which the use of the electric range figures. The guests are served with food prepared on the ranges. Following this a dance is usually arranged, the lady demonstrators providing the music. During the lunch and subsequent dancing an opportunity is afforded the demonstrators to ascertain the most likely range prospects; these are then followed up by business calls another day. These methods have proved to be very effective in securing range sales.

A Gramme Centenary.—M. Charles Mourlon, who is regarded as the doyen of Belgian electricians, has lately written an interesting booklet on the life work of Zenobe Gramme, the inventor of the Gramme ring, and of the first industrial dynamo, to commemorate the centenary of his birth. Gramme was born near Huy in Belgium on April 4th, 1826, and after serving his time as a carpenter became connected with an electrical firm in Paris. It was in 1867, at the age of 41 years, that Gramme took out his first patent for an electric generator, and although with but small resources, he decided to devote himself entirely to inventive work. After passing two years almost in poverty, he was awarded by the Institut de France in 1869 the Volta prize of 50,000 fr., established by Napoleon the Third for the most important electrical discovery. Gramme's fortunes then began to turn, and with the assistance of capitalists the Compagnie Gramme was established in Paris to exploit his inventions.

Automatic Telephones at Cheltenham.—There has just been completed for the British Post Office at Cheltenham, near Gloucester, a new trunk and local telephone exchange embodying automatic equipment. Both automatic and manual equipment was manufactured by the Automatic Telephone Manufacturing Co., Ltd., and at present the automatic switch-room serves 1,520 subscribers' and 200 p.b.x. lines, with provision for ultimate extension to 2,000 lines. There are 16 regular and two p.b.x. rotary lineswitch units of the usual standard type, the line switches being mounted on gates to facilitate inspection and adjustment. The final selectors are mounted on shelves at the opposite side of the lineswitch units, whilst the group selectors are accommodated on three selector trunk boards, each mounting six shelves per bay and accommodating 240 switches. Auxiliary equipment includes an m.d.f., link distributing frame, and a 7-bay meter rack with capacity for 300 meters per bay. There is also a one-bay meter rack for traffic meters, comprising congestion, overflow, total traffic and time unit meters. The system is 4-digit. Calls from manual subscribers in outer areas are extended to Cheltenham automatic subscribers by the manual operators, whilst outgoing calls to the neighbouring Cleeve Hill district reach the manual operators there *via* auto to manual repeaters, the Cheltenham subscriber who wants a Cleeve Hill number dialling 5. The manual equipment still necessary to maintain communication with other areas not yet converted to (Strowger) automatic working comprises a suite of 11 two-panel sections, of which nine are at present equipped. Commencing with a cable-turning section, there are three trunk signalling positions, each with seven cord circuits; one jack-ended junction position, with 17 cord circuits; three regular "A" positions, with 14 cord circuits; and two inquiry positions with eight cord circuits. Auxiliary manual equipment includes an i.d.f., special apparatus rack, a fuseboard and fuse alarm mounting board, and a meter cabinet for manual and dial-in junctions and peg count meters. The main batteries are of the Chloride Electrical Storage Company's manufacture, and comprise two sets of 25 S.B.9 elements in S.B.W. 15 lead-lined wood boxes. They are charged from the supply mains through the medium of a motor-generator. With a population of close upon 50,000, Cheltenham well merits (Strowger) telephone facilities.

Accident Prevention Course.—In announcing the first collegiate course in accident prevention organised by New York University and the American Museum of Safety, Mr. A. Williams, president of the latter, said: "The growing recognition of the need for checking the enormous human and economic loss due to accidents, bringing about an ever-increasing demand for men and women competent to organise and direct accident prevention campaigns in industry and in communities, has resulted in the development of a new profession, the members of which are variously termed safety engineers, directors of public safety, or merely safety men. In recognition of this development and because there is at present no school offering courses in safety engineering or in public safety campaign management, New York University is offering a course to equip men and women for leadership in this new field of work." The course in accident prevention will be open to all graduates and undergraduate students in New York University and the employés in the industries which are members of the museum of safety, and also to insurance safety inspectors, governmental officials and employés, industrial safety committee men, and others who through previous training or present association are professionally interested in accident prevention.

Electric Tramcars as "Safety First" Warnings.—In order to educate the public, and particularly children, as to the need for care in crossing roads in view of the ever-increasing traffic, a "Safety First" week was recently organised in Vienna. In connection with the event not only did the municipal authorities issue a number of warning posters, but one of the tramcars was specially painted with notices having a similar object and sent out each day over the various routes of the electric tramway system in the Austrian capital. With the same idea in view the municipal authorities of Breslau have recently had the sides of one of their tram-rail cleaning wagons painted with pictures and warnings of traffic dangers. These vehicles, having unbroken window-less sides, are well adapted for such a use, and as they usually travel at a relatively slow pace, the lessons taught by their external decoration cannot fail to be brought directly to the notice of the inhabitants.

Institution Notes.

Institution of Electrical Engineers. — NORTH-WESTERN CENTRE.—The report of the Committee for the 1925-26 session shows that 11 meetings were held at which the average attendance was 225; excluding two lectures, the average attendance at the remaining meetings was 150, compared with 117 in the previous session; 92 members took part in the Agecroft power station visit, the Faraday lecture was attended by 520, and a joint meeting with the Post Office Electrical Engineers attracted 600. One informal meeting and two social functions were held; in the discussions the total number of speakers was 68, compared with 67 last session. The membership increased by 23 to 1,092. The Students' Section held nine meetings, and arranged four visits to works and a social event; the average attendance was 42.

National Association of Supervising Electricians.—The following is the list of meetings at present arranged for the 1926-7 session:—

October 5th.—Presidential Address, Mr. A. M. Sillar
November 2nd.—Hot Water Supply, Mr. C. G. Nobbs.
December 7th.—Cables, Mr. A. I. Tracey.
January 4th.—The Transverter, Mr. W. E. Highfield.
February 1st.—Possibilities of Development of Water Power in Great Britain and Ireland, Mr. G. L. Addenbrooke.
February 26th.—Annual Dinner at the Holborn Restaurant.
March 1st.—Electric Lighting and Electrically-worked Apparatus on Railways, Mr. R. T. Smith.
April 5th.—Lighting of Small Towns, Dr. J. A. Purves.
May 3rd.—Members' Night.

Meter Engineers' Technical Association. — Arrangements for the first half of the 1926-27 session:—

September 23rd.—Presidential address. Mr. G. F. Shotter.
October 21st.—"The Testing of Large Capacity Meters in Situ." Mr. W. Casson.
November 18th.—"Points of View in Metering Theory." Mr. E. W. Hill.
The meetings are to be held at E.L.M.A. Lighting Service Bureau, 15, Savoy Street, W.C., at 7 p.m.

Our Personal Column.

(Electrical men are invited to enable us to keep readers of the "Electrical Review" posted concerning their movements.)

The Melbourne *Herald* reported recently that Mr. G. G. JOBBINS, M.I.E.E., who has for years been manager of the Geelong branch of the Melbourne Electric Supply Co., has been promoted to the position of engineer and manager of the company's headquarters in Melbourne, under the managing director, Mr. F. W. CLEMENTS, who has been appointed a member of the State Electricity Commission. Mr. R. H. MEAKIN, M.I.E.E., of Geelong, formerly assistant engineer, has been appointed engineer of the Geelong works.

Alderman ALBERT SMITH, chairman of the Keighley Corporation Electricity Committee, and formerly chairman of the Tramways Committee, has been invited to be the next Mayor of Keighley.

Mr. DAVID W. R. KNIGHTON, of Thrapston, who was formerly with the British Thomson-Houston Co., Ltd., has been appointed chief electrical engineer to the Ste. Madeleine Sugar Co., Trinidad.

The *North-East Kent Times* reports that Mr. H. A. NOTT, M.B.E., M.I.E.E., superintending electrical engineer at Sheerness Dockyard, has been transferred in a similar capacity to the Gibraltar Dockyard. His place will be taken by Mr. H. M. ACKERY, of Rosyth.

Mr. DAVID SARNOFF, vice-president and general manager of the Radio Corporation of America, arrived in London last week end after a visit to the Continent.

The *Electrical World* reports that Mr. EDGAR S. BLOOM, a vice-president of the American Telephone & Telegraph Co., has been elected president of the Western Electric Co. in succession to Mr. C. G. du Bois, who remains with the company as chairman of the board of directors.

Wills.—The late MR. JOHN H. J. HORNSBY, of Messrs. Ruston & Hornsby, Ltd., left unsettled property valued at £97,751 gross and £96,682 net.

The late Mr. F. S. SPIERS, O.B.E., B.Sc., secretary of the Faraday Society, left £1,655 (£1,524 net).

New Companies Registered.

Magneto Concessions Company (England), Ltd. (215,674).—Private company. Registered August 14th. Capital, £100 in £1 shares. Objects: To acquire the business of manufacturers of, agents and concessionaires for and dealers in motor accessories, dynamos, starter motors, &c., carried on by W. D. Meagher at 232, Deansgate, Manchester, as the "Magneto Concessions Co (England)." The first directors are:—W. D. Meagher and Mrs. M. Meagher, both of 4, Blair Road, Alexandra Park, Manchester. W. D. Meagher is managing director for life. Solicitor: H. E. Kay, 40, King Street, Manchester. Registered office: 232, Deansgate, Manchester.

F. Porter, Ltd. (215,704).—Private company. Registered August 17th. Capital, £500 in £1 shares. Objects:—To carry on the business of factors, manufacturers, licensors and licencees for electrical materials, appliances, tools, and apparatus, &c. The subscribers (each with one share) are:—F. Porter, 95, Churchill Avenue, Coventry, electrician; J. Raven, 15, Friars Road, Coventry, clerk. The subscribers are to appoint the first governing director, who shall be entitled to hold office for life. Secretary: F. Porter. Solicitors: Goate & Bullock, 35, Bayley Lane, Coventry.

Lighting Components, Ltd. (215,707).—Private company. Registered August 17th. Capital, £150 in £1 shares. Objects:—To carry on the business of dealers in, and manufacturers of electrical fixtures and fittings, electrical and radio engineers, dealers in all radio apparatus, &c. The first directors are:—W. H. Kay, 8, St. Stephen's Avenue, Whitegate Drive, Blackpool, electrical engineer; C. M. Phillips, 24, Park Drive, Blackpool, solicitor; W. S. Ashton, York House, Leamington Road, Blackpool (each of whom has signed the Memorandum of Association for 50 shares). Qualification, £10. Solicitor and registered office: C. M. Phillips, 30, Lytham Street Blackpool.

Craig & Mills, Ltd. (215,719).—Private company. Registered August 18th. Capital, £3,000 in £1 shares (2,000 preference and 1,000 ordinary). Objects:—To carry on the business of heating and ventilating engineers, electricians, mechanical engineers and manufacturers, fitters, tool makers, &c. The directors are:—Chas. T. Walker, "High Royd," Davies Avenue, Roundhay, Leeds, mill furnisher; George Clifford Mills, 244, Upper Chorlton Road, Whalley Range, Manchester, heating engineer. Qualification, £100. Secretary: G. C. Mills. Solicitor: J. Gregory, 6, Pall Mall, Manchester. Registered office: 22, Cooper Street, Manchester.

Radio, Motors and Cycles, Ltd. (215,753).—Private company. Registered August 19th. Capital, £6,000 in £1 shares. Objects:—To acquire the business carried on as the "Radio Electric Company," and to carry on the business of manufacturers of and dealers in radio apparatus and accessories, electrical engineering appliances or accessories, automobile, aircraft, and marine equipment, for lighting, starting or ignition, &c. The subscribers (each with one share) are:—J. V. Rushton, "Hill Crest," Coton Road, Wolverhampton, radio engineer; Mrs. F. Rushton, "Hill Crest," Coton Road, Wolverhampton. J. V. Rushden is managing director. The other first directors are to be appointed by the subscribers. Qualification, £500. Remuneration as fixed by the company. Secretary (*pro tem.*): C. Bassington. Solicitor: N. F. Steward, Wolverhampton.

Inoac Lamp Co., Ltd. (215,774).—Private company. Registered August 20th. Capital, £300 in £1 shares. Objects: To acquire the business of the Ino Guarantee Lamp Co., Ltd., carried on at 35, Aldermanbury, E.C., and to carry on the business of general merchants, factors, importers, exporters and agents (wholesale and retail) of electric lamps, wireless and electrical accessories, &c. The directors are:—W. L. Smith, 132, Altmore Avenue, East Ham, E.16, accountant; A. Harrison, 84, Park Street, Southend-on-Sea, electrical engineer. Qualification of above directors, 100 shares; of other directors, one share. Registered office: 35, Aldermanbury, E.C.

W. Muir Goodfellow & Co., Ltd. (14,282).—Private company. Registered in Edinburgh, August 19th. Capital, £3,000 in £1 shares. Objects: To carry on the business of electrical engineers and contractors, suppliers of electricity, carriers of passengers and goods, &c. The directors are:—W. M. Goodfellow, 218, Kilmarnock Road, Shawlands, Glasgow, electrical engineer; Mrs. J. Muir Goodfellow, 218, Kilmarnock Road, Glasgow; H. M. Muir Goodfellow, 11, Malvern Road, Bootle, Liverpool, marine engineer. Qualification, £1. Solicitors: Rob Walker & Orr. Registered office: 11, Berkeley Terrace, Berkeley Street, Glasgow.

Official Returns of Electrical Companies.

Power and Traction Finance Co. (Poland), Ltd.—Trust deed dated August 5th, 1926, to secure £205,000 second debenture stock (£110,000 Class "A," £50,000 Class "B," and £45,000 Class "C"), charged on (a) certain sums due or to become due to the company from five companies incorporated in Poland in respect of advances made or to be made to such companies, together with all securities therefor, including a mortgage created by Sila i Swiatlo (Power and Light) S.A., for £60,000 upon certain properties in Poland; (b) present and future property and assets subject to the specific charge created by a trust deed dated October 1st, 1924, between the company, the Commissioners of H.M. Treasury, and the British Overseas Bank, Ltd.; (c) moneys standing to the credit of an account opened in the name of the British Overseas Bank, Ltd., as trustees pursuant to an agreement dated August 4th, 1926, and all investments and deposits thereof; and (d) a second floating charge on the company's undertaking and property, present and future, including uncalled capital. Trustees: British Overseas Bank, Ltd.

Sheerness and District Electric Supply Co., Ltd. (65,749).—Capital, £75,000 in £1 shares. Return dated June 16th, 1926. All shares taken up. £75,000 paid. Mortgages and charges, nil

Central Electric and Radio Co., Ltd.—Particulars filed on August 7th of £300 second mortgage debentures authorised February 11th, 1926, charged on the company's undertaking and property, present and future, including uncalled capital, the whole amount being now issued. Also issue on July 29th of £200 debentures, part of a series already registered.

Walters Electrical Manufacturing Co., Ltd. (94,300).—Capital, £18,000 in £1 shares. Return dated July 21st, 1926. 16,875 shares taken up. £1 per share paid on 6,875 shares. £10,000 considered as paid on 10,000 shares. Mortgages and charges, nil.

Tramways Syndicate, Ltd. (58,292).—Capital, £2,500 in £1 shares. Return dated July 22nd, 1926. 1,507 shares taken up. £1 per share paid on 7 shares. £1,500 considered as paid on 1,500 shares. Mortgages and charges, nil.

John Davis & Son (Derby), Ltd. (66,606).—Capital, £35,000 in 20,000 ordinary and 15,000 preference shares of £1 each. Return dated July 9th 1926. 15,000 ordinary and 11,000 preference shares taken up. £26,000 paid. Mortgages and charges, nil.

Alliance Electrical Co., Ltd. (166,835).—Capital, £10,000 in £1 shares. Return dated May 12th, 1926. 3,854 shares taken up. £1,927 paid. £1,927 considered as paid. Mortgages and charges, nil.

Pope's Electric Lamp Co., Ltd. (101,293).—Capital, £25,100 in 25,000 preference and 100 ordinary shares of £1 each. Return dated July 20th, 1926. 23,579 preference and 100 ordinary shares taken up. £5,254 paid. £18,425 considered as paid. Mortgages and charges, nil.

T. W. Broadbent, Ltd. (95,420).—Capital, £5,000 in 560 ordinary and 440 preference shares of £5 each. Return dated July 30th, 1926. All shares taken up. £5,000 paid. Mortgages and charges, nil.

S. H. Heywood & Co., Ltd. (94,580).—Capital, £50,000 in £1 shares. Return dated May 1st, 1926. 31,999 shares taken up. £4,000 paid. £27,999 considered as paid. Mortgages and charges, nil.

South Metropolitan Electric Light and Power Co., Ltd. (47,875).—Capital, £500,000 in 250,000 ordinary, 150,000 cumulative first preference, and 100,000 cumulative second preference shares of £1 each. Return dated April 13th, 1926. All shares taken up. £492,132 paid on 247,500 ordinary, 144,632 first preference and 100,000 second preference shares. £7,868 considered as paid on 2,500 ordinary and 5,368 first preference shares. Mortgages and charges, £324,090.

Bournemouth and Poole Electricity Supply Co., Ltd. (55,189).—Capital, £800,000 in 75,000 4½ per cent. preference, 175,000 6 per cent. preference, 150,000 new preference, and 400,000 ordinary shares of £1 each. Return dated April 29th (filed July 15th), 1926. 75,000 4½ per cent. preference, 175,000 6 per cent. preference, and 360,000 ordinary shares taken up. £550,000 paid on 75,000 4½ per cent. preference, 175,000 6 per cent. preference and 300,000 ordinary shares. £60,000 considered as paid on 60,000 ordinary shares. Mortgages and charges, £187,500.

Coatbridge and Airdrie Electric Supply Co., Ltd. (89,178).—Capital, £200,000 in £1 shares. Return dated April 29th, 1926 (filed July 15th). 158,200 shares taken up. Nil paid on 157,200 shares. £1,000 considered as paid on 1,000 shares. Mortgages and charges, nil.

Electric Construction Co., Ltd. (39,292).—Capital, £400,000 in £1 shares (100,000 preference and 300,000 ordinary). Return dated June 24th, 1926. 62,780 preference and 300,000 ordinary shares taken up. £116,490 paid on 36,490 preference and 80,000 ordinary shares. £246,290 considered as paid on the remainder. Mortgages and charges, £135,270.

Geo. Bray & Co., Ltd. (76,185).—Capital, £160,000 in £1 shares (80,000 preference and 80,000 ordinary). Return dated June 2nd, 1926. 55,000 preference and 55,000 ordinary shares taken up. £7 paid on 7 shares. £109,993 considered as paid on 109,993 shares. Mortgages and charges, £40,000.

Cuttings Bros., Ltd. (Old Co.).—C. J. Pain, of 18, Low Pavement, Nottingham, ceased to act as receiver or manager on August 10th, 1926.

Lumos Radio Valve Co., Ltd.—A. Hart, of 442, Strand, W.C.2, was appointed receiver on August 9th, under powers contained in mortgage debenture dated July 14th, 1926.

Edmundson's Electricity Corporation, Ltd. (52,013).—Capital, £800,000 in 400,000 ordinary and 400,000 preference shares of £1 each. Return dated July 7th, 1926. All shares taken up. £600,400 paid on 200,400 ordinary and 400,000 preference. £199,600 considered as paid on 199,600 ordinary. Mortgages and charges, £352,473.

Horstman Gear Co., Ltd.—Satisfaction in full on August 12th, 1926, of debentures dated October 27th, 1920, securing £5,000.

City Notes.

Reports and Meetings of Electrical Companies, Dividend Results, &c.

Enfield Cable Works, Ltd.

The annual meeting was held on August 19th, the Earl of Verulam presiding. In proposing the adoption of the report, the chairman, after referring with regret to the deaths of Mr. Francis Hird and Mr. A. V. Downton, late directors, said he was once more fortunate in submitting a balance sheet which was certain to meet with the approval of the shareholders. In the early part of the year 47,944 ordinary shares were issued at a premium of 25s., which brought the issued capital up to £450,000. The reserve fund had been increased from £20,000 to £60,000, and after paying the final dividend on the ordinary shares, the carry forward would be larger than the amount brought in by some £4,000. On the asset side of the balance sheet it would be noted that the stock was up by £44,000. That was partly due to some large deliveries of copper which came in in June, and partly to the fact that prior to May, as a precaution against the possibility of a general strike, they laid in extra stocks of materials. They had the money to pay for these and they had the orders on their books to ensure that they would be able to use them, and they were not certain whether, in the event of a general strike, it might not still be possible for them to carry on at the factory, whilst they felt sure it would be difficult to get in supplies. Summarising the financial position, and bearing in mind that the sundry debtors included an amount of £40,000, which was more often cash than debtors, and that the stock item included an amount of £50,000, which was more often cash than stock, it appeared that they had £170,000 of liquid assets, or after paying the final dividend proposed, which would absorb some £30,000 of cash, they still had some £140,000 of liquid assets. The turnover for the year under review, exceeded that of the previous year by 8 per cent., and the profit exceeded the corresponding profit of the previous year by 16½ per cent. That showed that the increase in the turnover was not achieved by taking on work at less remunerative rates, but was a normal expansion due to the general increase in trade in the things which they produced. Another interesting figure was that, omitting the month of May, the increase in the turnover for the remaining 11 months, was over 10 per cent., the turnover for May having fallen to 70 per cent. of the average monthly turnover of the remainder of the year. Luckily, the strike interfered with them for four days only. During the remainder of that anxious period they were working with almost their entire staff. The Enfield Cable Works (Australasia), Ltd., had experienced a year of steady progress and now had some £5,000 of profit standing to its credit in Australia. Enfield Rolling Mills, Ltd., was established in the early part of last year, and last August he told them that he did not expect they would feel the benefit of that venture even in the year that had just ended. That had proved to be the case. It took them some 12 months to get

the whole machine—and a copper rolling mill was really one huge machine 100 yd. long and 25 yd. wide—into proper working order. For practical purposes they could report to-day that the rolling mill was running well, and turning out a product which competed in price and quality, and in the coming year they might look upon that asset as something which had ceased to give trouble or anxiety, and begun to contribute its quota to the general revenue. Some of them might wonder why it was felt desirable to keep the large liquid cash position, which the accounts exhibited. Great progress was being made in the art of cable making, and to enable a company such as theirs to keep abreast of the times, reserves and a liquid cash position were essential. There were developments which might shortly compel them to install new plant for the production of "super-tension" cable, and the directors felt that no prudent shareholder would cavil at a conservative policy on the part of the board. Sir George Sutton, Bt., seconded the motion, which was carried unanimously.

German Company.

The *Robert Bosch Company*, Stuttgart, reports that activity increased month by month in 1925 to the end of the year, when a change took place as the absorbing capacity of the German market for motor cars declined. Only the igniter works, whose output for the most part was exported, remained abundantly occupied. Although the total turnover was increased as compared with the previous year, the net profits declined from 7,942,000 marks in 1924 to 3,818,000 marks last year; the rate of dividend, however, is maintained at 8 per cent. as in 1924, but its distribution has been postponed. An increase took place in the business with the representative companies in England, America, Sweden and Italy, and with the representatives in France, while business in Buenos Aires satisfactorily developed, although no profits were realised. The future course of trade is said to depend upon the development of the automobile industry, and the cheapening of the products as much as possible, and the availability of sufficient working funds will be of still greater importance in the coming years. Work in this direction is proceeding and also in that of an increased turnover; and the company has this year raised a foreign loan of $3,000,000. As a new product is mentioned the introduction of battery ignition which is finding a market under the pressure of American competition in Europe with the cheaper motor cars, while in England it is gradually being ousted again by the magneto.

Aberdeen Suburban Tramways Co., Ltd.—The accounts for the six months ended July 31st last show a loss of £791. Against this is placed a sum brought forward of £3,317, leaving a credit balance of £2,526. After paying directors' fees it is proposed to carry forward a balance of £2,426. The company's running powers over the Aberdeen Corporation's lines ceased as from June 8th last, but negotiations are proceeding for their resumption. Suggestions for the sale of the undertaking to the Corporation failed to elicit an offer. Meeting: August 31st.

Hellenic Electric Railways Co., Ltd.—In compliance with Stock Exchange regulations this company issued during the week a statement as to its constitution and objects. The company, which has an authorised and issued share capital of £418,000, and has issued bonds amounting to £400,000, has undertaken the exploitation of the Athens Piræus Railway and/or other steam or electric railways and tramways, as well as the supply of electricity. The directors all bear Greek names.

Montreal Light, Heat and Power Consolidated.—In accordance with resolutions passed by shareholders on July 26th, each $100 par value share is being converted into one 6 per cent. cumulative redeemable preferred share of $50 par value, and three common shares of no par value.

Oxford Electric Co., Ltd.—An interim dividend at the rate of 5 per cent. per annum has been declared on the ordinary shares, as in 1925.

Stock Exchange Notice.—Dealings in the following securities have been officially allowed under Rule 159:—

International Telephone and Telegraph Corporation.—200,292 new shares of $100 each, issued at par, partly paid and fully paid.

Stocks and Shares.

MONDAY EVENING.

CONDITIONS in the coal dispute vary so constantly that Stock Exchange markets appear to find it a little difficult to keep up with the capricious changes that come with such frequency. At the end of last week, when a fresh deadlock seemed to have been reached, there was a little tendency to offer shares: a weakening of prices amongst iron and steel shares showed the disposition of the moment. This week, however, expectations have revived of a gradual resumption of work through the process of the men going back by degrees to the pits, and the consequence of this is that industrial shares have rallied in most of the different sections.

It is considered somewhat remarkable that, throughout the whole of the sixteen weeks during which the coal crisis has lasted, prices of London electricity shares should have remained so noticeably firm. A few declines have occurred, but nothing of moment. In the list of provincial supply issues, the downward tendency became more marked. Amongst the latter, however, the fall has been comparatively slight, when it is remembered that the big provincial undertakings work in districts that are peculiarly affected by coal, and by conditions that surround the industry. It may be said that shareholders already discount the practical certainty that the next reports and dividends will reflect uncomfortably the state of affairs prevalent during the past four months, but people are looking ahead, and they expect to see such a recovery in future trade as will compensate for the losses sustained by capital at the present time. Whether or not the miners themselves will get a great deal out of their long holiday is considered more debatable. Past experience suggests that a prolonged strike seldom does much good to anybody; least of all to the men and their families, who suffer by its continuance.

The list of home electricity supply shares shows no alterations on the week. Business in the principal issues has been exceedingly quiet. There is, in fact, hardly anything doing. On the other hand, lively animation prevails in this department devoted to the utility companies' shares of the Latin-Canadian group. Of these, Brazilian Tractions continue to hold the field for active interest, there being a widely-spread area of attention that stretches from Montreal to Brazilians. The price of the shares has risen 10 points to 120. Mexico Tramways dipped to 15 before they recovered to 19, the latter price showing a rise on the week. Barcelona Tractions are steady at 37. Sidros from 13¾ fell abruptly to 12, from which there was a rally to 12½. Perak Hydro Electric 7 per cent. debenture has been changing hands fairly constantly about 3¾ discount for the partly-paid scrip. The fully-paid, which came out at 96, stands at 92½.

Investment is asking to what extent the electric power and supply companies of the provinces are likely to be influenced by the coal strike, a question that is a great deal easier to pose than it is to answer. In 1925 the companies as a whole did well, in spite of the depression of trade and the check that this laid upon commercial enterprise. Improvements in profits were secured by the Folkestone, the Isle of Thanet, Newcastle, Clyde Valley, South Wales, and Northampton Companies. Llanelly recorded a very slight decline, but this was the only important provincial concern that failed to make progress last year. The Oxford Electric Company repeats its previously-paid interim dividend at the rate of 5 per cent., and the price of the shares is 27s. 6d. The coal crisis has lasted since the end of May, and it is impossible to suppose that the companies will escape its malevolent influence, although, on the other hand, the extension of the use of electric cookers and labour-saving appliances in the home is likely to be quickened by the coal shortage imposed upon the housewife.

Most of the shares in the electrical equipment and cable manufacturing companies are better. The reason is that informed circles are quoted as stating the companies to be full of work. It is said that the manufacturing concerns are busier than ever. The fact remains that shares in the popular undertakings continue to mount steadily in price. There are rises in Electric Constructions, Henleys, Johnson & Phillips, Metropolitan-Vickers ordinary, and one or two others. The Metropolitan-Vickers Electrical Co. has secured a useful contract from the Great Indian Peninsula Railway, and the other companies are declared, as already mentioned, to be fully and profitably employed.

Reference was made here a fortnight ago to the placing of half-a-million pounds London General Omnibus 5 per cent. income debenture stock. The first line was sold at 84½. Consistent demand has raised the price to 85¾. Home Railway stocks are better, Metropolitans and Districts showing rises. Underground Electric Railways shares of both classes have strengthened. The extension of the City & South London line from Clapham Common to Morden, now about to be opened for traffic, helped to quicken interest.

The Rangoon Electric Tramway & Supply Company offers its shareholders 100,000 ordinary shares of £1 each at 16 rupees per share. The existing shares are quoted at about 27s. Anglo-Argentine Tramways 5 per cent. debenture is 1½ higher at 75. British Columbia Railway stocks again advanced. Montreal Light & Power is better at 243. A modest line of Barcelona Traction 6½ per cent. prior lien bonds is obtainable at 100¼.

Cable stocks remain good, and Chili Telephones rose to 7½. Orientals followed suit with an advance to 46s. 3d. Nothing further had transpired, up to Monday night, concerning the offer that has been made for the undertaking of the Venezuela Telephone Company; the price of the shares is 24s. 3d., the newly-issued ordinary being at the same level. Marconis attract no fresh public interest. Aron Meters are 15s. 6d., Ericsson Telephone preference 21s. 9d., and Enfield Cable ordinary 75s.

Babcock & Wilcox had been down to 50s. 9d. before the market veered round, upon which the price quickly became 52s. Iron, steel, and similar shares mostly stand higher than they did a week ago. The rubber market is quietly firm. Shares in the best companies are so well held that difficulty is experienced in buying any of them. The raw product keeps merely steady.

Share List of Electrical Companies.

	Nom. £	Dividend, 1924	Dividend, 1925.	Price Aug. 23 1926.	Rise or fall.	Yield. p.c.
Home Electricity Companies.						
Bournemouth and Poole	1	1/4	1/4	£4/6	—	5 2 9
Brompton Ordinary	1	10	10	32/3	—	*6 4 0
Charing Cross Ordinary	1	15	15	44 6	—	6 14 10
do. do. 4½ Pref.	1	4½	4½	17/6	—	5 2 10
Chelsea	1	12	12	2	—	6 0 0
City of London	1	15	15	47/3	—	6 7 0
do. do. 6% Pref.	1	6	6	22/6	—	5 6 8
Clyde Valley	1	8	8	27/-	—	5 18 6
County of London	1	15	15	69/6	—	5 0 10
do. do. 6 % Pref.	1	6	6	22/6	—	5 «
Edmundson's Ordinary	1	7	8	24/3	—	6 13 0
do. 7% Pref.	1	6	7	22/6	—	6 4 5
Elec. Supply Corporation	1	10	10	31/3	—	6 8 0
Kensington Ordinary	5	15	15	13½	—	5 11 1
Lancs. Light and Power	1	7½	7½	24/-	—	6 5 0
London Electric	1	10	10	32/6	—	6 3 1
do. do. 6% Pref.	5	6	6	5/7½	—	5 10 8
Metropolitan	1	11	11	37/-	—	5 18 11
do. 4½% Pref.	1	4½	4½	17/6	—	5 1 0
Midland Counties	1	6½	6	20.6	—	5 17 1
Newcastle-on-Tyne Ordinary	1	7	7	21/3	—	6 11 9
do. 5% Pref.	1	5	5	18/9	—	5 6 8
do. 7% Pref.	1	7	7	24/-	—	5 16 8
Notting Hill 6% Pref.	10	6	6	10	—	6 0 0
North Met. Elec. 6% Pref.	1	6	6	22/6	—	5 6 8
St. James' and Pall Mall	5	17½	17½	16¼	—	5 8 6
South London	1	15	15	28	—	5 14 3
South Metropolitan Pref.	1	7	7	26/3	—	5 6 8
Urban Ordinary	1	4	7	1¼	—	6 4 5
do. 6% Pref.	1	6	6	20/6	—	5 17 1
Westminster Ordinary	1	15	15	42.6	—	7 1 3
Whitehall Elec. Invst. 7½% Pref.	1	7½	7½	26/3	—	5 5 0
Yorkshire Elec.	1	8	8	27/-	—	5 18 6
Home Rails.						
Central London Ord. Assented	Stock	4	4	70	—	5 14 4
Metropolitan	„	5	5	64	+1	7 16 4
do. District	„	3½	3½	52	+½	6 14 7
Underground Electric Ordinary	10	Nil	Nil	8¾	+¼	NB
do. do. 'A'	1/-	Nil	Nil	11 6	+6d.	Nil
do. do. Income	Bonds	6	6	103	—	*5 16 6
Telegraphs and Telephones.						
Anglo-Am. Tel. Pref.	Stock	6	6	104½	—	5 14 10
do. Def.	„	1½	1½	24¾	—	6 1 3
Automatic Telephone	1	3	5	2⅞	—	4 2 1
Chili Telephone	5	5	6	7¼	+⅛	*4 4 3
Cuba Sub. Ord.	10	5	5	6¾	—	7 5 6
Eastern Extension	10	10	10	19½	—	*5 4 8
Eastern Tel. Ord.	Stock	10	10	189½	—	*5 5 6
Globe Tel. and T. Ord.	10	10	10	19½	—	*5 4 8
do. do. Pref.	10	6	6	11¼	+¼	5 7 10
Great Northern Tel.	10	22	20	37½	—	7 5 6
Indo-European	25	8½	10	46½	—	*5 7 6
Marconi	1	10	Nil	15/-	—	... ...
Marconi Marine	1	10	7½	20/-	—	7 10 0
Oriental Telephone Ord.	1	12	12	46/3	+1/3	*5 3 10
United R. Plate Tel.	5	8	8	8⅝	—	*4 17 9
Western Telegraph	10	10	10	18½	—	*5 7 8
Home and Foreign Trams, &c.						
Anglo-Arg. Trams First Pref.	5	5½	5½	3	—	9 3 4
do. do. 2nd Pref.	5	6	6	2½	—	11 3 2
do. do. 5% Deb.	Stock	5	5	75	+1½	6 13 4
British Electric Traction Ord.	„	7	8	134½	—	5 18 11
do. do. 6% Pref.	„	6	6	110	—	5 9 1
Brazil Traction	100	4	5	120	+10	4 0 0
Brit. Columbia Elec. Rly. Pcs.	Stock	5	5	86½	—	5 15 7
do. do. Preferred	„	96/-	126/9	110½	+1	*5 15 9
do. do. Deferred	„	129/6	8	157	+1	*5 16 10
do. do. Deb.	„	4½	4½	79	—	5 7 7
London & Sub. Trac. 5% Pref.	1	2½	Nil	5/-	—	Nil
London United Tram. Deb.	Stock	4	4	47	—	8 10 2
Mexico Trams 5% Bonds	—	5	5	71½	—	6 19 10
Mexican Light Common	100	Nil	Nil	31½	—	Nil
do. Pref.	100	Nil	Nil	23½	—	Nil
do. 1st Bonds	—	5	5	68½	—	6 7 6
Yorkshire (West Riding)	1	5	—	11.6	—	... ...
Manufacturing Companies.						
Babcock & Wilcox	1	12	13	51/3	+1/3	*4 17 8
British Aluminium Ord.	1	5	10	46 9	—	4 3 9
British Elec. Transformer Pref.	1	Nil	7	18/9	—	7 9 4
British Insulated Ord.	1	15	15	3⅝	—	4 8 11
Brush Ord.	1	10	10	25/9	—	7 15 4
Callenders	1	15	15	3½	—	4 12 4
do. 6½% Pref.	1	6½	6½	23/9	—	5 9 5
Crompton Ord.	1	Nil	Nil	13/3	—	... ...
Edison-Swan	4/-	10	10	11/-	—	3 12 9
do. 5% Deb.	Stock	5	5	86	—	5 16 3
Electric Construction	1	10	10	31/3	—9d.	6 8 0
Enfield Cable, Pref.	1	7½	7½	1½	—	6 6 4
English Electric	1	5	Nil	15/9	+9d.	... ...
do. do. Pref.	1	6	6	18/-	—	6 13 4
Gen. Elec. Pref.	1	6½	6½	22/6	—	5 15 7
„ Ord.	1	5	7½	30.3	+1/-	4 19 2
Henley	1	16	23	8½	+⅛	5 1 7
do. 4½% Pref.	5	4½	4½	4¼	—	5 6 0
India-Rubber	1	5	5	23/-	—	*4 6 11
Johnson & Phillips	1	10	17½	63/-	—	5 11 1
Met.-Vickers Ord.	1	8	8	25/9	+1/3	6 4 9
do. Pref.	2	8	8	2¾	—	6 14 9
Siemens Ord.	1	7½	7½	30/-	—	6 4 9
Telegraph Construction	12	20	10	28½	—	*4 8 6

*Dividends paid free of Income Tax.

Market Quotations for Chemicals and Metals.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general and they may vary according to quantities and other circumstances.

CHEMICALS, &c.		Price Aug. 24th.	Fortnight's inc. or dec.
a Acid, Oxalic	per lb.	5¾d.	...
a Ammoniac, Sal	per ton.	£60	...
a Ammonia, Muriate (large crystal)	„	£52	...
a Bisulphide of Carbon	„	...	...
a Borax	„	£25	...
a Copper Sulphate	„	£25 10s.	...
a Potash, Chlorate	per lb.	4d. to 4½d.	...
a „ Perchlorate	„	5½d.	...
a Shellac	per cwt.	£15 15s.	...
a Sulphur, Commercial	„	£9 10s.	...
a „ Roll	„	£9 10s.	...
a Soda, Chlorate	per lb.	3¾d. to 3¾d.	...
a „ Crystals	per ton.	£5 to £5 5s.	...
a Sodium Bichromate, casks	per lb.	4d.	...
METALS, &c.			
b Aluminium, Ingots	per ton.	£120 to £125	...
b „ Wire	per lb.	1/9 to 2/6*	...
b „ Sheet	„	1/6 to 2/-	...
p Babbitt's Metal and Anti-friction Metal—			
Grade I	per ton net.	£257	£5 dec.
Grade II	„ „	£180	£4 dec.
Grade III	„ „	£96	£3 dec.
c Brass (rolled metal 2" to 12" basis)	per lb.	9½d.	...
c „ Tubes (solid drawn)	„	1/0 to 1/1½d.	...
c „ Wire, basis	„	10½d.	...
c Copper Tubes (solid drawn)	„	1/1	...
c „ Bars (best selected)	per ton.	£90	...
c „ Sheet	„	£90	...
c „ Rod	„	£90	...
d „ (Electrolytic) Bars	„	£87 5s.	...
d „ „ Sheets	„	£144 10s.	...
d „ „ Wire Rods	„	£77 5s.	...
d „ „ H.C. Wire	per lb.	9¼d.	...
f Ebonite Rod	„	2/3 to 2/6	...
f „ Sheet	„	2/3 to 2/6	...
n German Silver Wire	„	2/2	...
h Gutta-percha, fine	„	8/-	...
h India-rubber, Para fine	„	1/7½	¾d. inc.
f Iron Pig (Cleveland No. 3.)	per ton.	72/6	...
f „ Wire, galv. No. 8, P.O. qual.	„	£21	...
g Lead, English pig	„	£31 15s.	10s. dec.
g Mercury	per bot.	£15 7s. 6d. to £15 10s.	...
e Mica (in original cases) small	per lb.	3d. to 8/-	...
e „ „ medium	„	4/- to 8/-	...
e „ „ large	„	10/ to 20/- & up.	...
p Phosphor Bronze, plain castings	„	1/3½	...
p „ „ drawn bars & rods	„	1/3	...
p „ „ rolled strip & sheet	„	1/2¾	...
p „ „ wire	„	1/3¾	...
o Platinum	per oz.	£23 10s.	...
d Silicium Bronze Wire	per lb.	11½d.	...
r Steel, Magnet, in bars	„	7½d.	...
n Tin, Block (English)	per ton.	£295 5s. to £290 10s.	£5 15s. to £6 5s. dec.
n „ Wire, Nos. 1 to 16	per lb.	4/3	...

*For 1 cwt. lots. Special quotations against definite specifications.

Quotations supplied by

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
l Boiling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p C. Clifford & Son, Ltd.
r W. F. Dennis & Co.

National Fuel and Power Committee.—The Government has set up a Standing Committee of 13 members, with Sir Alfred Mond as chairman, to carry out a recommendation of the Royal Commission on the Coal Industry (1925), its terms of reference being: To consider and advise upon questions connected with the economic use of fuels and their conversion into various forms of energy, having regard to national and industrial requirements and in the light of technical developments. The members of the Committee, in addition to the chairman, are: Mr. J. Baker, Labour M.P. for Bilston, Assistant Secretary of the Iron and Steel Trades Confederation; Mr. Mark Brand, colliery director; Sir John Cadman, technical adviser, Anglo-Persian Oil Company, Member of the Council of Scientific and Industrial Research; Sir Arthur Duckham, specialist in furnace work, carbonisation of coal and engineering connected with chemical developments; Sir William Hart, Town Clerk, Sheffield; Mr. Frank Hodges, secretary of the International Miners' Federation, and formerly general secretary of the Miners' Federation of Great Britain; Professor F. A. Lindemann, F.R.S., Professor of Experimental Philosophy at Oxford; Sir David R. Llewellyn, colliery director; Mr. M. Mannaberg, director of iron and steel companies, and chairman of the Fuel Economy Committee of the National Federation of Iron and Steel Manufacturers; Mr. C. H. Merz, consulting engineer, specialist in electric traction, power supply problems, and fuel economy; Sir Alexander Walker, director of John Walker and Sons, Ltd., distillers; Mr. D. Milne Watson, governor of the Gas Light and Coke Company. The secretary of the new Committee is Mr. W. Palmer, and the assistant secretary, Mr. R. J. Moffatt. Communications should be addressed to the Secretary, National Fuel and Power Committee, Board of Trade, Great George Street, London, S.W.1.

Exports and Imports of Electrical Goods and Machinery in July, 1926.

THE July statistics of our foreign electrical trade give cause for satisfaction; for the first time since February the exports show an increase above those of the preceding month, and not since April had the figures for the corresponding month of last year been exceeded. The increase both as compared with June last and with July, 1925, was a substantial one, and it would appear as though the harmful effect of the general strike has been spent.

The rise in the export section was well spread over the individual items; indeed, there were only two decreases—and those of small proportions—*viz.*, in railway and tramway motors and switchboards. The most notable increase occurred in the case of "other motors and generators," which rose by over 50 per cent. above the June figures, although in the truer comparison (with July, 1925) the increase was not so pronounced. This does not apply to the second largest rise, in unenumerated electrical machinery, for whereas the addition to the June total amounted to £74,366, the increase upon the figure for July last year was £106,042. The growth in the exports of batteries and accumulators is deserving of mention, being, in fact, the largest proportional increase in comparison with the June figures. It is to be hoped that this is the commencement of a movement which will before the end of the year wipe out the adverse balance of £900,403 given by a comparison of the first seven months of 1925 and 1926.

Although the net difference in the import totals was small, some of the items showed large fluctuations. The greatest of these were a decrease of £22,233 in unenumerated electrical goods and a rise of £11,934 in wires and cables. Inconsistency was exhibited in the case of unenumerated electrical machinery, which was well below the June figure but above that of July, 1925.

The re-export total showed an increase of about 40 per cent. over the previous month's level; this was accounted for by substantial rises in four of the items; the total was, however, below that of the corresponding month of last year. The net result of the changes in the statistics was an improvement in the balance in our favour (making no allowance for re-exported goods) from £764,993 in June to £1,227,317 in July, a rise of about 60 per cent.

	Exports.			Imports.			Re-Exports.		
	Electrical exports for July, 1926.	Inc. or dec. as compared with June, 1926.	Inc. or dec. as compared with July, 1925.	Electrical imports for July, 1926.	Inc. or dec. as compared with June, 1926.	Inc. or dec. as compared with July, 1925.	Electrical re-exports for July, 1926.	Inc. or dec. as compared with June, 1926.	Inc. or dec. as compared with July, 1925.
Electrical goods and apparatus (unenumerated)	£205,035	+ £54,925	+ £46,561	£84,931	− £22,233	− £4,488	£6,315	+ £2,994	− £412
Insulated wires and cables	260,657	+ 47,812	+ 59,893	58,862	+ 11,934	+ 25,796	3,139	+ 1,906	+ 1,558
Glow lamps	50,099	+ 15,340	+ 11,928	18,581	− 5,390	− 20,864	319	− 97	+ 189
Arc lamps and parts	860	+ 399	+ 562	665	+ 356	+ 386	3	− 4	− 2
Batteries and accumulators	127,077	+ 73,261	+ 39,302	53,480	+ 6,018	+ 7,424	295	− 231	− 1,582
Meters and instruments	35,990	+ 9,215	+ 15,722	17,990	− 2,757	− 10,945	716	+ 86	− 152
Carbons	1,098	+ 317	+ 198	5,497	+ 1,934	− 1,023	15	—	− 105
Electrical Machinery—									
Electrical machinery (unenumerated)	304,723	+ 74,366	+ 106,042	104,622	− 22,109	+ 11,221	9,000	+ 4,300	+ 4,114
Railway and tramway motors	25,056	− 450	− 28,808	—	—	—	—	—	—
Other motors and generators	198,543	+ 101,227	+ 15,289	—	—	—	—	—	—
Switchboards (not telegraph or telephone)	7,897	− 2,356	− 218	15	− 128	− 145	—	− 20	− 187
Telegraph and Telephone Cable and Material—									
Telegraph and telephone wires and cable (not submarine)	71,055	+ 33,563	+ 29,806	10,903	+ 6,229	− 794	2,023	+ 1,594	+ 1,705
Submarine telegraph and telephone cable	34,921	+ 31,515	− 14,720	5,500	+ 5,500	+ 5,500	—	—	—
Telegraph and telephone instruments and apparatus	297,433	+ 7,523	+ 39,142	32,031	+ 4,919	− 3,429	3,780	+ 180	− 7,132
Totals	£1,620,441	+ £446,657	+ £320,693	£393,127	− £15,667	+ £8,639	£25,635	+ £10,708	− £2,016
		Exports.			Imports.			Re-exports.	
Decreases for seven months of 1926		£900,403			£339,065			£41,777	

The Electrical Imports of New Zealand.

THE following table shows the values of electrical and allied goods imported into New Zealand in 1925, according to the recently-issued official trade returns. The figures for 1924 have been given for purposes of comparison, and notes of increases or decreases added:—

	1924.	1925.	Inc. or dec.
Electric batteries and cells—	£	£	£
Total	81,000	85,000	+ 4,000
From United Kingdom	18,000	16,000	− 2,000
,, United States	59,000	58,000	− 1,000
,, Canada	2,000	7,000	+ 5,000
,, Denmark	1,000	1,000	—
Generators, motors and transformers—			
Total	525,000	540,000	+ 15,000
From United Kingdom	334,000	342,000	+ 8,000
,, United States	119,000	102,000	− 17,000
,, Sweden	23,000	46,000	+ 23,000
,, Canada	10,000	15,000	+ 5,000
,, Belgium	12,000	8,000	− 4,000
Insulated cable and wire—			
Total	666,000	613,000	− 53,000
From United Kingdom	615,000	573,000	− 42,000
,, United States	7,000	23,000	+ 16,000
,, Canada	21,000	11,000	− 10,000
,, Australia	16,000	3,000	− 13,000
Electric lamps (incandescent filament)—			
Total	106,000	128,000	+ 22,000
From United Kingdom	67,000	79,000	+ 12,000
,, Netherlands	23,000	30,000	+ 7,000
,, United States	10,000	11,000	+ 1,000
Other electric lamps—			
Total	33,000	30,000	− 3,000
From United Kingdom	5,000	6,000	+ 1,000
,, United States	25,000	22,000	− 3,000
Carbons in blocks—			
Total	38,000	50,000	+ 12,000
From United Kingdom	26,000	40,000	+ 14,000
,, United States	10,000	8,000	− 2,000
,, Australia	1,500	1,000	− 500
,, Canada	1,000	—	− 1,000
Cooking and heating appliances—			
Total	14,000	28,000	+ 14,000
From United Kingdom	3,000	3,500	+ 500
,, Canada	10,000	22,000	+ 12,000
,, United States	1,000	2,500	+ 1,500

	1924.	1925.	In. or dec.
Telegraph material and apparatus—	£	£	£
Total	48,000	80,000	+ 32,000
From United Kingdom ...	19,000	20,000	+ 1,000
,, United States	14,000	18,000	+ 4,000
,, Belgium	13,000	36,000	+ 23,000
Telephones and accessories—			
Total	88,000	102,000	+ 14,000
From United Kingdom ...	28,000	6,000	− 22,000
,, United States	22,000	24,000	+ 2,000
,, Sweden	5,000	1,000	− 4,000
,, Belgium	27,000	65,000	+ 38,000
Other electrical material—			
Total	546,000	544,000	− 2,000
From United Kingdom ...	344,000	335,000	− 9,000
,, United States	152,000	140,000	− 12,000
,, Australia	10,000	12,000	+ 2,000
,, Canada	25,000	44,000	+ 19,000
Electricity meters—			
Total	64,000	59,000	− 5,000
From United Kingdom ...	60,000	55,000	− 5,000
,, Holland	1,000	—	− 1,000
,, United States	1,000	2,000	+ 1,000
Recording and testing instruments for meters—			
Total	57,000	84,000	+ 27,000
From United Kingdom ...	34,000	61,000	+ 27,000
,, United States	16,000	15,000	− 1,000
Gas, oil, and hot-air engines, exceeding 100 b.h.p.—			
Total	19,000	13,000	− 6,000
From United Kingdom ...	19,000	8,000	− 11,000
,, Sweden	—	1,000	+ 1,000
,, United States	—	4,000	+ 4,000
Steam engines, stationary, exceeding 200 b.h.p.—			
Total (mainly from United Kingdom)	3,000	5,000	+ 2,000
Turbines, steam and water, and Pelton wheels, exceeding 200 b.h.p.—			
Total	32,000	18,000	− 14,000
From United Kingdom ...	29,000	14,000	− 15,000
,, Switzerland	—	3,000	+ 3,000
,, Sweden	3,000	—	− 3,000

The Construction of Electric Heating and Cooking Utensils.

By PROF. H. BOHLE, M.I.E.E.

(*Abstract of a paper in the I.E.E. Journal.*)

THE paper describes some new types of elements and utensils for electric cooking.

When a heating element is placed in a cooking utensil, the conditions of working are entirely different from those which obtain when a wire is heated in free air. Radiation has now practically disappeared and is replaced by conduction, and the quality and reliability of a utensil depend mainly upon the quality of the heat conduction. The fall of temperature between the heating wire and the metal surface to be heated is expressed by—

θr = watts per cm^2 × thickness of insulation/heat conductivity of insulation.

This equation tells us that the thickness of the insulating material should be as small as possible, and that the heat conductivity of the insulator should be high. The most suitable material is clear mica, not micanite. It withstands great heat, is mechanically strong, so that very thin sheets may be used, and it does not fall to pieces when heated to a high temperature. For a sheet of pure mica 0.025 cm. thick, the fall of temperature for one watt per cm.^{2} is given by—

$$0.025/3.76 \times 10^{-3} = 7 \text{ deg. C.},$$

which is very low. It is, however, essential that no air pockets can form anywhere. Still air is about the best heat insulator which we have, so that the fall of temperature across an air pocket will always be high. A gap of only 1 mm. length may result in a serious drop. Too much emphasis cannot, therefore, be placed on the necessity of making sure that every inch of the heating wire is firmly pressed against the surface which is to be heated. This applies not only to the heating wire proper, but also to the connection from the element to the terminals.

The author has constructed an element, fig. 1, which has no under-surface. It consists of a sheet of pure mica, to which is fixed a helical spiral of nichrome wire. The various convolutions of the spiral are separated from one another by means of magnesia insulating tubes slightly less in diameter than the helix. When the element is firmly pressed against the bottom of the vessel, which is accomplished by means of a single screw and a suitably sprung steel plate, the helix is reduced to the diameter of the magnesia tubes, so that the whole element forms practically a solid plate. This ensures good heat conductivity, and the specific load may be as high as 6 W per cm.^{2} without raising the temperature of the heating wire beyond the safe limit. Fig. 3 shows a saucepan fitted with this type of element. Replacement is very easy, and the saucepan may also be dipped into a bucket of water without endangering the element, in spite of the fact that the lower portion is not soldered to the upper one. There are two spirals fixed to a sheet of mica, for 600 and 400 W respectively, which may be used separately or in parallel or in series, so that 1,000-W, 600-, 400-, and 250-W loadings may be obtained. A suitable loading for such a vessel is about 4 W per cm^2 of surface, though it may be raised to 5 W. Aluminium or tinned copper will be found satisfactory for such saucepans. Pure nickel is now coming into fashion and gives excellent results, but is expensive.

Pure nickel is undoubtedly the best material that can be employed, as it has a very high melting point and is easily kept clean. It has also a high scrap value.

Aluminium possesses the disadvantage of a low melting point, and results have usually been very unsatisfactory. It is also a curious fact that heat preserves aluminium, and a saucepan of that material with an element will last much longer than one without an element, care, of course, being taken that there is always something in the vessel when the current is on. Tinned copper possesses the disadvantage of requiring tinning fairly frequently. For large saucepans, tinned iron has also been used. Large vessels should always be lagged to reduce the loss of heat. The efficiency of the 2½-litre saucepan, fig. 3, was 88 per cent. when bringing cold water to the boiling point for the first time. This shows the great advantage of the saucepan with an element over the use of hot plates. The author does not advocate the use of hot plates. They are slow and inefficient, especially if ordinary ill-fitting cooking utensils are placed thereon. In an ordinary household the hot plate is usually employed for one operation only, when the efficiency will rarely be more than 40 per cent., even if the greatest care is taken, and it may be as low as 30 per cent. Yet in spite of this fact, large electric ranges with numerous hot plates are still being manufactured, with the result that those who buy them, mostly at a high price, soon find out that they cannot afford the bills for energy at the end of the month. The efficiency of the plate depends largely upon the weight of the plate and whether it is used for one operation only or for continuous work. The burning out of an enclosed hot plate, if left standing idle on load, may be prevented by supplying the plate with corrugations. Such a plate is shown in fig. 2. Even if made of aluminium it can be left idle under full load for half an hour or more, whilst if made of cast iron it can be used as a radiator. It may also be used as an element for a baking oven, for which it has proved very satisfactory. Comparative tests were carried out with two different types of hot plates, one of which was very light (not substantial enough for household purposes), whilst the other was very heavy. In both cases the same cooking utensil was employed and the same quantity of water was brought to the boiling point. The results show conclusively that a heavy hot plate is a very inefficient article if the operation is to be performed once only and if the quantity of water or food is small. When the quantity of water was increased to 4,000 grammes, the efficiency of the lighter plate fell from 71 to 66.4 per cent., whilst that of the other plate was increased from 31 to 44.3 per cent. When the plates were used a second time, immediately after the first operation, the efficiency of the light plate increased by only 4 per cent. (from 71 to 75), whilst that of the heavy plate rose to 66.8 per cent. This shows that a heavy plate is suitable for continuous work and large quantities of foodstuff, and a light plate for single operations. The light plate, which absorbs only 850 W against 1,766 W of the heavy plate, is too small for large quantities.

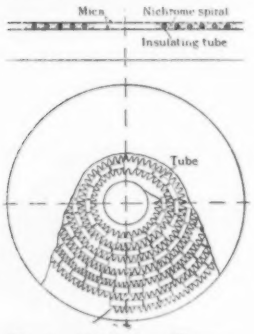


Fig. 1.—Uni-Surface Element.

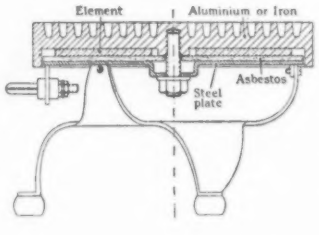


Fig. 2.—Corrugated Plate.

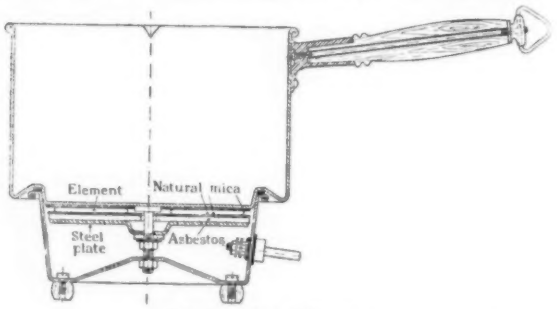


Fig. 3.—Electric Saucepan.

The British Association.—III.

The Oxford Meeting.

Power Factor Correction by Condensers: The Influence of Voltage Harmonics.

By EDWARD HUGHES, B.Sc., PH.D., A.M.I.E.E.

(Abstract of paper read before Section G—Engineering.)

The author had occasion to determine the value of the capacity required to raise to unity the power factor of an alternating-current ceiling fan; the p.f. of the fan motor was 0.51. When the calculated capacity was connected in parallel, and the supply was taken from an alternator A having a fairly good wave-form, the p.f. given by the power and volt-amperes was only 0.815; when the supply was taken from another alternator B, the p.f. was 0.74. As the current taken by the fan motor was practically sinusoidal, the trouble is due to the harmonics in the voltage wave being accentuated by the condenser. The p.f. obtained with different capacities has been plotted in fig. 1, curves A and B representing the values

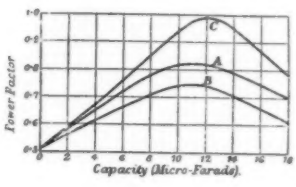


Fig. 1.

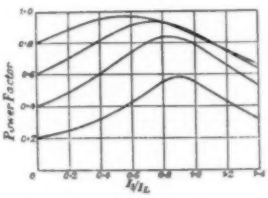


Fig. 2.

for alternators A and B respectively. By connecting a three-phase balanced non-inductive load across A, the wave-form of its e.m.f. could be so modified that a maximum p.f. of 0.99 was obtainable, the variation of p.f. with capacity under these conditions being as represented by C in fig. 1.

It may be argued that these results are of little importance, since alternators can now be designed to give almost a pure sine wave of voltage; but there are in operation a large number of alternators, particularly salient-pole machines, the voltage waves of which contain prominent harmonics. It is therefore of interest to examine the extent to which power-factor correction can be carried out by condensers when the voltage wave is non-sinusoidal and to consider briefly its reaction upon the cost of electrical energy.

Since condensers are usually installed by the consumer in order to reduce the cost of his electrical energy, consider only the case wherein the *power* (and not the kVA) remains constant. Examining the effect of harmonics in the capacity current for a particular value of the harmonic voltage and for a given initial p.f., it is simple to calculate the p.f. obtainable with a given ratio of I_1/i_L (the ratio of the kVA of the condenser as usually calculated from sinusoidal quantities to the kVA of the load), and the curves show the improvement in p.f. for different initial power factors obtained with—

(*a*) A 3rd harmonic voltage=10 per cent. of fundamental (fig. 2).

(*b*) A 25th harmonic voltage=1 per cent. of fundamental (fig. 3).

(*c*) A 25th harmonic voltage=5 per cent. of fundamental (fig. 4).

Fig. 5 illustrates the effect when there are no harmonics, and figs. 4 and 5 show that with a prominent high harmonic, such as a tooth ripple, the power factor due to a capacity that

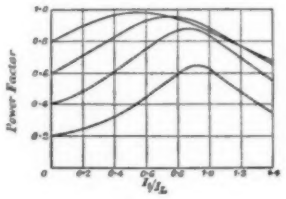


Fig. 3.

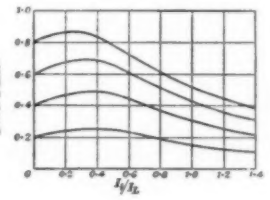


Fig. 4.

would have given unity p.f. with sinusoidal waves may be less than the initial value. When there are no harmonics, the rate of change of p.f. with the kVA capacity of the phase-advancing apparatus is a maximum when the power factor is 0.82—a fact demonstrated by fig. 5. From figs. 2, 3, and 4, however, it is obvious that the lower the initial p.f., the lower is the p.f. at which the rate of improvement of the power factor attains its maximum value, and, consequently, the lower is the most economical p.f. of that section of the supply system; also, the greater the magnitude and the higher the frequency of the harmonic, the lower is the most economical power factor. The tariffs for alternating-current in Great Britain may be divided into: (1) those involving a charge per kVA of maximum demand, as indicated by a kVA demand meter, and (2) those involving an adjustment of the charge depending upon the power factor of the system. The most common types of maximum-demand meters are: (*a*) The thermal pattern, and (*b*) the induction pattern, with or without voltage compensation.

The thermal indicator registers the full effect of the harmonics. Consequently, if condensers were installed with the idea of increasing the p.f. from an initial value of 0.5 up to unity (on the assumption of no harmonics), but if only a p.f. of 0.8 were attained, the reduction in the consumer's maximum demand would be 37.5 instead of 50 per cent., and he would be required to pay 25 per cent. more on his maximum demand owing to the presence of harmonics.

As regards the induction-type of demand meter, there seems to be no experimental data on the effect of frequency on this type of instrument. To determine this effect, tests were carried out on an inverse time-lag relay (N.C.S.) of the induction type, from which fig. 6 has been deduced; the torque per ampere at various frequencies has been plotted in terms of the torque per ampere at 50 cycles, and it will be seen that up to about the 19th harmonic, the torque per ampere in this instrument may be anything up to 3.5 times that at 50 cycles. Hence, from the standpoint of the consumer, the induction-type of demand indicator is more unfavourable than the thermal type when condensers are being used to improve the power factor of a system having a non-sinusoidal voltage wave.

The conclusions are that the power factor of a system having harmonics in the voltage wave cannot be increased to unity by means of condensers. When a consumer is being charged on the kVA of maximum demand as indicated on a demand meter, he is penalised by the presence of harmonics in the condenser current, particularly if the demand meter is of the induction type; under these circumstances his most economical p.f. will be less than that based on sinusoidal wave forms. When the p.f. determining the charge to the consumer is taken from a power-factor meter, or from the ratio of meter readings, the consumer may obtain practically full benefit from the

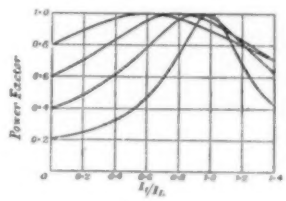


Fig. 5.

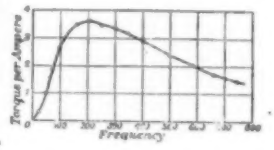


Fig. 6.

installation of condensers, and his most economical p.f. is, for practical purposes, the same as that based on sinusoidal wave forms.

The author thanks the principal and governors of the Brighton Technical College for facilities to carry out the experimental work described in this paper.

Some Phenomena of Electric Conduction.

By PROF. W. CRAMP, D.Sc.

(Abstract of paper read before Section G.—Engineering.)

An electric current is generally held to be due to the *relative* motion of protons and electrons. Thus, if $-e$ be the electronic charge, N the number of protons or of electrons per cubic cm., U the drift of the protons, and V the parallel drift of the electrons, then the current density is—

$$-NeV+NeU=Ne(U-V).$$

This argument receives support from the work of Rowland, but his experiments are not conclusive. It is also in accord with the general facts of electrolysis. But there is no experimental proof of the assumption that a negative charge of given magnitude moving at a given speed produces the same magnetic effect as a similar positive charge moving at the same speed in the opposite direction. In metallic conduction it is generally supposed that the electrons only drift. In electrolytic conduction both anions and cations drift. The question arises, therefore, "Is the magnetic field produced by an electrolytic conductor the same as that obtained when a metallic conductor of similar form carries the same current?" Sheldon and Downing in 1898 attempted experiments to settle this question, and found no difference between the two cases, but their method is open to much criticism. Physics text-books generally state that there is no difference, but they give no proofs. The author's plan was to compare the magnetic field produced by a tube of electrolyte carrying a given current with that produced by the same current when the tube was full of mercury. The electrolytes used were respectively silver nitrate and hydrochloric acid. Two methods of measurement were adopted for the magnetic field, namely, (1) the ballistic galvanometer method, and (2) the direct-reading magneto-

meter. In all cases the magnetic field due to the silver nitrate was less than that due to the mercury, and that due to the hydrochloric acid was slightly less than that due to silver nitrate. Further, by both methods the percentage difference was very nearly the same, *i.e.*, just under 2 per cent. as between mercury and hydrochloric acid.

Examination of the possible causes of this difference shows that if the field were produced by electrons only the differences should be far greater. If it were due to the fact that in the electrolyte the drifting charges are loaded with drifting masses of matter, while in the mercury they are not, the differences should be much less. The results are not in harmony with the supposition that there is a difference between the magnetic field produced by the proton drift and that due to an electron drift. The author was finally driven to the conclusion that the difference is due to the fact that in concentrated electrolytes a storage of energy is proceeding side by side with conduction. Thus, electrolysis is not an example of simple convection. The existence of the store can be proved by apparatus which allows of the discharge of the energy through a ballistic galvanometer, and it is then found that the energy stored depends largely upon the time that electrolysis has been proceeding. The curve of discharge is very similar to that of a condenser with a high resistance in series, suggesting that the electricity is stored directly and not by a chemical transmutation. Change of resistance due to temperature and of density due to decomposition may account for the facts observed.

The conclusion is that the usual assumptions concerning the relationship between current and electron or proton movement are correct for metallic and for electrolytic conductors; but that where a circuit contains both, the new electrode phenomena must be taken into account.

Discussion.

Professor A. E. KENNELLEY (Cambridge, Mass., U.S.A.) said the matter discussed in the paper was of very great importance from the theoretical point of view. The question was, first, whether a wire in the form of a glass tube containing an electrolyte would have the same magnetic field at a perpendicular distance from it as the same wire converted into copper. If they assumed that it would have just the same magnetic field, then the question involved was whether the current entering the two wires, as read on an ammeter, would show the same phenomena, or whether there would be storage of electricity going on inside the liquid wire, and no storage of electricity going on in the case of the copper wire. That was quite conceivable, and it was a matter of very great theoretical interest. They only used metallic wires in practice, however, and not liquid wires, so that he supposed the question was not likely to become of material practical importance. The fundamental subject of conduction of electricity in solids and liquids was of very great importance, and ought to be thoroughly investigated and discussed.

The PRESIDENT said that the subject was a very fascinating one, and suggested that if those who had followed Professor Cramp's investigations could assist him by suggestions, they might communicate with him.

Broadcast Radio-telephony: Its Influence on Education.

By J. C. STOBART.

(Abstract of address before Section L—Education, by the Director of Education of the B.B.C.)

The speaker commenced his address by stating that as the British Broadcasting Company would shortly be changing its status, it should be placed on record that it was the managing director of a limited company who conceived the sphere of broadcasting to include a definite responsibility towards education. At the present time there was scarcely one broadcast station in the world which did not use this instrument to some extent for educational purposes; even the American stations, which were regarded as purely commercial undertakings, had their definite educational programmes. Similarly, France, Belgium, Germany, Holland, and other countries had definite educational programmes. Great Britain, in a more quiet and informal way, perhaps, had been, and still was, a pioneer in educational broadcast; before the B.B.C. was formed, there had been some experimental work at the Writtle station; later, the B.B.C. took steps to form in each centre where there were stations advisory educational committees composed of leading local educationists, whose advice and co-operation was invited. In 1924 a successful demonstration was given for the Board of Education, and shortly afterwards Mr. Stobart was loaned by the Board to act as Director of Education to the B.B.C. It was quickly found, however, that the work involved more than a man's spare-time services, and Mr. Stobart resigned from the Board of Education in order to devote his whole time to the task of the B.B.C.

During the 1924 experiments in the technique of broadcasting to schools, those carrying them out were painfully aware of the fact that anything in the nature of failure would irretrievably damage the whole of the future prospects of the use of wireless for educational purposes, because of inherent official hostility to anything new; the higher one got in the educational world, the stronger was the bias against new things, but it was satisfactory that only one educational authority reported definitely against the advantages of wireless school transmissions. It was now claimed that the experimental stage had been satisfactorily concluded, though better organisation of reception was required before complete satisfaction could be felt with the service; that could only be obtained by definite effort on the part of the authorities in discarding inferior apparatus, a remark which also applied to the ordinary listener wishing to take full advantage of the broadcast educational facilities. Nevertheless, an immense number of adults now followed with interest the evening courses of lectures, and many hundreds of teachers regularly used wireless in their school programme. Co-operation with universities had been secured at all stations and, in connection with school transmissions, examinations had been held with very satisfactory results, but even to-day the official educational world maintained an attitude of benevolent neutrality. To the official, that was an exceedingly congenial attitude, and it would be a pity to disturb it; nevertheless, considerable progress was being made, and more than 1,000 schools in the areas of the London and Daventry stations had installed wireless apparatus and were using the transmissions as part of their regular curricula.

The B.B.C. had been by no means ungenerous in spending money upon an object which could not conceivably bring in any commercial return, but the resources of the wireless studio were unlimited, and it could bring the voice of the greatest expert to the multitude in a manner not possible in any other way. Technical difficulties had restricted the scope of educational broadcasting, but with the institution of an alternative wave-length system (expected soon) it should be possible to make considerable further progress, since the present need of reconciling instruction with entertainment in one programme would then be avoided.

Whilst agreeing that set lessons were perhaps the main feature of all education, that other great feature—inspiration—could in no better way be stimulated than by listening to lectures by the greatest experts in their particular subjects. Wireless was the best way of elevating the depressed intellectuality of the countryside. In a few months there would be increased facilities from the Post Office which would enable alternative programmes to be submitted, thus allowing more educational matter to be broadcast.

Economic Aspects of the Labour Outlook.

By SIR LYNDEN MACASSEY, K.B.E., K.C.

(Abstract of paper read before Section F.—Economic Science and Statistics.)

The author discussed measures for the furtherance of industrial stability, and the improvement of the relations between employers and employed. Peace in industry, he said, would not fall as a gift from Heaven, or be gathered as the fruit of any system of industrial reconstruction imposed by legislation. It seemed to be attainable only by a process of exhaustive and fair-minded negotiation within each industry, along the lines of compromise peculiar to the genius of our people.

Although the view that industrial stability must spring, in this country at any rate, from effective collective agreement between employers and the trade unions, was obviously not accepted by quite a number of our so-called "captains of industry," there was no doubt that employers, no less than trade unions, had reaped enormous advantages from a system of collective agreements. It was a national calamity that in Great Britain, alone of all the great industrial countries, the trade unions should attach to it the disastrous doctrine of restricted output. It was essential to industrial concord that agreed minimum rates of wages and conditions of employment should be observed by all employers and accepted by the workers. Claims by the "individualistic" employer of his "right to manage his own business" as he thought fit, and to pay such wages as he chose, said Sir Lynden, found in him no responsive note. He would subscribe without hesitation to making it obligatory upon all employers in an industry to be members of the federation of employers representing that industry, and compelling the workers in it to become members of the representative trade unions. If that were at present a counsel of perfection, there was a practical alternative, namely, that the rates and conditions agreed to should, by law, be made obligatory upon all employers and workers in the industry.

One of the chief causes militating against the negotiation of collective agreements was not so much a difference of opinion as to the terms of the agreement as the extreme unsuitability of many employers' organisations and trade unions for undertaking and carrying out expeditiously the difficult negotiations involved. Anyone who had had experience of industrial negotiations must have discouraging recollections of how utterly inappropriate, ponderous, cumbersome, and slow-moving was the machinery, and how clumsy the procedure of ordinary industrial negotiation.

The strongest consideration which entered into the negotiation of a collective bargain was the question which side could last out the longer if there were a strike. To-day, inasmuch as the workman who went on strike could obtain from Poor Law relief substantial subsistence for his wife and family, and from his union out-of-work benefit sufficient pocket-money for himself, there was little economic disparity between the relative powers of the employers and the workers to last out.

While they might hope to see, as education advanced, some of the economic power of the contesting parties in collective bargaining subordinated to the needs and welfare of the community, it was to be recognised that the millennium was not yet. It had been remarkable recently to hear some well-intentioned Bishops whose acquaintance with economics apparently fell far short of their knowledge of theology, proposing to reconstruct a great national industry on the basis of a collective agreement founded on vague principles of benevolent subsidisation by other industries, in defiance of plain and equitable

economic law. Such an episcopal palace of industry would soon prove to have been built on sand, and very disastrous would be its ultimate collapse.

Experience since the war had revealed a growing cause of industrial instability. Every time a trade union now made a collective agreement it seemed to enter into it with a mental reservation or to read into it an implied term that, notwithstanding any conditions in the agreement to the contrary, the trade union, though not the employers, might at any time break it, if that violation seemed likely to secure some benefit to the workers. Primarily this was because the Trade Union Act, 1871, provided most foolishly and short-sightedly that no agreement between trade unions and an association of employers could be enforced at law. It was also due to the circumstances that in few trade unions was there any recognised procedure by which a collective agreement was submitted to a ballot for acceptance by the members.

Two main lines of effort were suggested as a means of improving stability: First, by endeavouring to facilitate the making of agreements between employers and trade unions, and secondly, by ensuring that the agreements, when made, were honoured in spirit and in letter, and enforced, if necessary, by law. Except in a few industries, the Whitley Council had been a failure because of the reluctance of employers to establish district councils and set up works committees. The Central Joint Industrial Council was little more than a debating society. If an industry were not prepared itself to set up proper negotiating machinery, there was a case for imposing such machinery upon the industry by force of law. Trade unions should have just as much power to make contracts as any trading corporation, and that should carry with it full legal responsibility for any breach of contract. In most foreign countries trade unions were treated as responsible corporations; in this country we still persisted in treating them as the illegitimate offspring of industrial democracy.

If the true nature of a collective agreement were recognised, the case was made out at once for declaring sympathetic strikes to be illegal. If sympathetic strikes were barred, direct action must be laid under a still more stringent interdict. From disputes over the interpretation of industrial agreements when they had been made, much industrial instability resulted, and once a collective agreement had been made, its interpretation should be a matter for a Court of Law. All that was wanted was to accord legal force to the decisions of the existing Industrial Court.

Discussing whether strikes and their disastrous effects on industry could be prohibited, Sir Lynden did not think it would be either possible or right to make all strikes illegal and to attempt to introduce compulsory, as distinguished from voluntary, arbitration. If, however, collective agreements were enforceable at law, that would have the effect automatically of stopping the numerous strikes which took place with regard to the interpretation of an agreement and as reprisals for alleged violations. Provision could be made for a longer notice being requisite for termination of the contract of employment. In every case strikes could be prohibited until the dispute had been dealt with, with reasonable expedition, by the conciliation machinery of the industry.

With regard to public utility services, which called for special consideration, he would have no hesitation in subscribing to the proposition that strikes in connection with communal services and services of public utility should be declared illegal, or in providing by law that it should be a condition of employment in such services that any dispute as to wages or conditions should, if the ordinary conciliation machinery failed to adjust it, be referred to and decided by the Industrial Court, whose decision should be binding upon the industry. But even the alteration of the law to that effect would not relieve any Government from the duty of keeping at all times an organisation on foot capable, in the event of a strike, of carrying on the public services.

Discussion.

Sir JOSIAH STAMP, who urged the need for some certainty of outlook for those engaged in industry, said the question that had been raised in his mind was, if agreements between capital and labour were made legally enforceable and their breach punishable, what would happen to trade-union officials whose members committed a breach? Would the leaders be imprisoned and would the funds of the union be impounded, and were the funds to be impounded even in a case in which the union had pursued a policy opposed to the views of a considerable minority of its members? Also, how was an employer to be forced into a federation, or a workman into a union? Was each to be imprisoned in the case of a refusal to join?

Mr. ARNOLD LUPTON emphasised the futility of thinking that, under a system of legal enforcement, employers could pay a wage that their industry could not afford. The less the Government had to do with any business the better for that business.

Mr. H. H. NEILSON (National Union of Railwaymen) said that the root of all the industrial trouble was the suspicion that existed between employers and employed, and a serious attempt to remove this must be undertaken if peace was to be secured. Employers and employed should meet across the same table and take a scientific, as distinct from an emotional, interest in industrial peace and progress.

Mr. F. ROBY (Oxford) suggested that if it were made compulsory for all workmen to become members of a trade union, it would attack seriously the individual liberty of the very big proportion of men who were non-unionists. The same objection applied to any attempt to force employers into a federation.

The Transference of Energy in Collisions Between Electrons and Molecules.

By Professor J. S. TOWNSEND (Wykeham Professor of Physics, Oxford).

(Abstract of paper read before Section A—Mathematical and Physical Science.)

This paper contained a description of experiments made at the Electrical Laboratory, Oxford, from which some of the effects that take place in collisions between electrons and molecules of gases have been deduced. The effects which are obtained depend on the velocity of the electrons, and it is necessary to adopt different methods of studying the phenomena which occur in ranges of large and small velocities of impact.

The investigations of collisions in which the velocity of impact of the electrons was small (from about one-tenth of a volt to 10 volts), were based on the determinations of the velocity of agitation u, and the velocity w in the direction of the electric force, of electrons moving in a field of uniform electric force.

The average value of the proportion of the energy of an electron which is lost in a collision with a molecule is approximately $2.4 \times w^2/u^2$. In diatomic gases the loss of energy in a collision is greater than in monatomic gases.

In helium the proportion of the energy of an electron lost in a collision was found to be 2.4×10^{-4}, which is approximately the value of the ratio $2\ m/M$, m/M being the ratio of the mass of an electron to the mass of an atom of helium. In neon the loss of energy in a collision is less than in helium, and in argon the loss is less than in neon. Although these losses are small, they are of importance in experiments on the conductivity of gases when there are a large number of collisions between each electron and molecules of the gas.

With larger velocities of impact, an electron loses energy in large amounts in some of the collisions, and additional electrons are obtained which cause an increase in the current through the gas. When certain definite large amounts of energy are transferred from an electron to an atom, the atom may be ionised or the state of the atom may be changed so that it emits radiation. In the latter cases the atoms of the gas are not ionised.

The increase in the current may be attributed either to ionisation of atoms of the gas or to the photo-electric effect of the radiation from the atoms on the electrodes.

Experiments were made to determine the relative importance of these two effects when the electric force and the gas pressure were adjusted so as to obtain large increases in the currents due to the motion of the electrons through the gas. In helium and in neon it was found that the increase in current due to the photo-electric effect was small (less than 1 per cent.) compared with the effect of ionisation by collision.

In another set of experiments it was found that in the initial stages of the development of large currents there was no appreciable increase of current due to positive ions by ionisation of atoms of the gas or by setting free electrons from the negative electrode.

The initial stages in the development of large currents were also determined with an apparatus with two electrodes, in which the distance between the electrodes was adjustable and the electric force was maintained at a constant value.

The results of these experiments were represented by means of curves giving the current in terms of the distance between the electrodes, and a method of analysing the curves was explained, whereby it was possible to determine the causes of the variations obtained in the rate of increase of the current with the distance between the electrodes.

In helium an increase in current was obtained at the point where the potential difference between the electrodes was about 21 volts, and in neon at the point where the potential difference was about 17 volts, but for large distances between the electrodes the rate of increase of the current with the distance was much greater in helium than in neon. The analysis of one of the curves indicated that immediately after a collision in which an atom of helium was ionised, the average energy of the original electron and that of the electron set free from the atom was about seven volts. Also in helium the number of collisions in which there was a large transference of energy to atoms which were not ionised was small compared with the number of collisions in which atoms were ionised.

In neon the collisions of the former type occurred more frequently, and when the gas pressure was adjusted to obtain large increases in current, the number of atoms which absorbed energy in large amounts without being ionised was about the same as the number of atoms which were ionised.

The B.E.S.A. Glossary of Terms Used in Electrical Engineering: A Protest and a Suggestion.

By PROF. G. W. O. HOWE.

(Abstract of paper read before Section G—Engineering.)

THE British Engineering Standards Association has recently published a volume entitled "British Standard Glossary of Terms used in Electrical Engineering" (British Standard Specification No. 205—1926). It consists of eleven sections and two appendices. The sub-sections of Section 1 are as follows:—Elemental terms; fundamental electrostatic terms; fundamental magnetic terms; derived terms; units; technological terms; apparatus; mechanical and general terms. In my opinion this is the most important and the least satisfactory section in the book. Sub-section 12, that is, the second sub-section of the first section, "Fundamental Electrostatic Terms," contains the following definitions:—

No. 1,207. *Unit Electrostatic Tube of Force.*—"An electrostatic tube of force having a cross-sectional area, at right angles to the lines of force and at a point where the electric force is unity, of 4 π square centimetres." Now, although this has been suggested, and is in some ways preferable, it is not the usual convention according to which the number of lines or tubes of force per square centimetre at any point is made equal to the electric force at the point. At any point where the electric force is unity, as on a sphere of 1 cm. radius about a unit charge in a vacuum, the tubes of force should have an area of 1 sq. cm. No. 1,207 would give a single line or tube of force from a unit charge in a vacuum, whereas according to the usual convention 4π lines or tubes of force emanate from unit charge.

No. 1,208. *Electrostatic Flux.*—"The number of unit electrostatic tubes of force traversing a given surface. The total flux over a surface enclosing a charge is equal to the charge." Here we have a hopeless confusion between two different things, *viz.*, the electric force and the displacement produced by the force. Consider, for example, a concentric spherical condenser, the inner and outer electrodes of which are maintained at a constant difference of potential. No. 1,401 tells us that potential difference "is measured by the work done in moving unit charge of electricity from one point to the other"; hence, since the potential difference is constant, the force on a unit charge in the space between the electrodes will be independent of the permittivity, although the charge on the condenser will be proportional thereto. Since the force is unaltered, the number of tubes of force crossing the dielectric is unaltered and yet, according to No. 1,208, the total flux is the number of unit tubes of force and is equal to the charge.

No. 1,209. *Unit Electrostatic Flux.*—"The electrostatic flux in a unit electrostatic tube of force."

No. 1,210. *Electrostatic Flux Density.*—"The electrostatic flux per unit area, normal to the direction of the flux; symbol: D."

Here, again, is a hopeless muddle. The symbol D has always been regarded as representing the displacement, *i.e.*, the charge or quantity of electricity displaced across unit area normal to the direction of the displacement, and it is rightly called the electrostatic flux density as stated in No. 1,210, but No. 1,209 makes it all meaningless by confusing the electrostatic flux with the electrostatic force, whereas the relation between them depends on the permittivity of the medium. If a medium has different permittivities in different directions, the resultant electrostatic flux may not even be in the same direction as the electric force. The reason for the confusion is the failure to distinguish between cause and effect. When a material is subjected to a mechanical stress, a strain or displacement is produced, the relation between the stress and the strain depending on the properties of the material. In a somewhat analogous way an electrical stress or electrostatic force produces an electrical displacement or electrostatic flux density in the material, the relation between the two depending on the electrical properties of the material.

Turning from electrostatic terms to the much more commonly employed magnetic terms, one might have expected some improvement, but one finds the same confusion of ideas. Magnetic force is correctly defined in terms of unit magnetic pole, and magnetic flux density is harmlessly defined as the magnetic flux per unit area, but what is one to make of the following:—

No. 1,307. *Magnetic Flux.*—"The number of unit magnetic tubes of force traversing a given surface. Symbol: ϕ."

This makes the definition of permeability quite meaningless, since it is defined as: "The ratio of the magnetic flux produced by a given magnetic force in the material or medium to the magnetic flux which would be produced by the same magnetic force in a perfect vacuum." Seeing that the flux is defined in No. 1,307 as the number of tubes of force, the ratio is not likely to change on passing from one medium to another.

No. 1,314. *Magnetomotive Force.*—"The total of the magnetic potential differences along the whole length of a magnetic line of force." A student of electrical engineering is usually introduced at an early stage of his course to a toroid or anchor ring of iron uniformly wound with insulated wire through which a current is passed, and finding that there is no tendency whatever for the magnetic flux to leave the ring at one point and cut across to enter at another, he wisely concludes, in his innocence, that all parts of the iron ring are at the same magnetic potential, however large may be the magnetising current. He is then shown that the magnetomotive force acting around the ring must be 0.4π times the ampere-turns. How, then, can the magnetomotive force be the sum of all the potential differences? Moreover, the definition is misleading in that the path around which the magnetomotive force is determined need not be a magnetic line of force at all.

The trouble really begins at No. 1,312. *Magnetic Potential Difference.*—"A magnetic condition existing between two points and tending to cause a charge of magnetism to move from one point to the other. It is measured by the work done in moving a hypothetical unit pole from the one point to the other." By what path? Strictly speaking, the potential theory is not applicable when it is possible to follow a path linking current-carrying coils, since the work done in moving unit pole from one point to the other depends on the path followed, and it was the student's innocence of this and other troubles, such as multi-valued functions, that enabled him to conclude that all parts of the ring were at the same potential. Why complicate matters by dragging magnetic potential differences into the definition of magnetomotive force? How much simpler it would be to say that the m.m.f. around any closed path is the work done in moving unit pole once around that path.

No. 1,316. *Reluctance of a Magnetic Circuit.*—"The ratio of the magnetomotive force acting in the circuit to the resulting magnetic *force*." Surely this is a misprint for *flux*, but the two terms are used in such a manner that it may be intentional. If so, it is confusion worse confounded.

There appears to be some effort made to distinguish between "magnetic force" and "magnetising force," although what distinction is intended it is difficult to see.

No. 1,313. *Magnetic Force.*—"The force exerted on a unit magnetic pole situated at the point considered."

No. 1,315. *Magnetising Force.*—"The magnetomotive force per centimetre, measured along the lines of force, in the case of a magnetic flux set up by a current of electricity flowing in a magnetising coil. Symbol: H."

The symbol H is thus reserved for the latter force, which can only be caused by a current of electricity. Magnetic force has no symbol, but is, presumably, produced by bringing a magnet near the point. Seeing, however, that *Magnetic Force* is "the force exerted on a unit pole," that *Magnetic Potential Difference* "is measured by the work done in moving the unit pole from one point to the other," that *Magnetomotive Force* is "the total of the magnetic potential differences along the whole length of a magnetic line of force," and that "*Magnetising Force*" is "the magnetomotive force per centimetre measured along the lines of force," it is extremely difficult to discover where any difference between *Magnetic Force* and *Magnetising Force* can have crept in. Somehow or other, the latter only is designated by H, whereas the former, by a combination of Nos. 1,306, 1,307, and 1,309, becomes identically the same thing as flux density, and is designated by B, whilst in No. 1,316 it becomes identified with total magnetic flux ϕ. Truly a most elastic term.

No. 1,322. Although a matter of little importance, attention may be drawn to the fact that the definition of *Electromagnetic Induction* covers only self and mutual induction, but excludes the induction of e.m.f. due to the movement of magnets in the neighbourhood of coils.

The distinction drawn between magnetic force and magnetising force makes it interesting to note that in No. 1,336, *Susceptibility* is "the number obtained by dividing the intensity of magnetisation by the *magnetic force* producing it"; whereas in No. 1,339 *Magnetic Hysteresis Loop* is "the closed figure formed by plotting the values of the flux density per square centimetre (B) against the *magnetising force* (H)." It would be interesting to know if these distinctions are intended and, if so, on what they are based.

Turning from the so-called fundamental terms—such as excitation and hysteresis loop—to the so-called derived terms—such as potential and electromotive force—we find further difficulties.

No. 1,402. *Potential.*—"Electrical, at a point. The potential difference between that point and surrounding bodies, all of which are assumed to be at an infinite distance therefrom." Whatever does this mean? Seeing that the surrounding bodies may all be at very different potentials, which of them is to be chosen as a basis for the determination of the potential difference? Moreover, the removal of the surrounding bodies to an infinite distance, or indeed any movement of them at all, will generally alter the potential at the point.

No. 1,405. *Electromotive Force.*—"An electric condition tending to cause a movement of electricity in a circuit. It is measured by the sum of the potential differences from point to point round the circuit."

A simple example will serve to expose the utter fallacy of this definition. On page 14 of a little book intended for second-year students, and entitled "Exercises in Electrical Engineering," by Professor Mather and the writer, will be found an interesting problem which I commend to the careful consideration of those responsible for this definition. The pole of a bar magnet is plunged into the centre of an endless ring of copper wire, causing a momentary current of 1/20 ampere to flow in the ring, which has a resistance of 1 ohm. Now, what is the momentary potential difference between two opposite points on the ring? The student usually begins by multiplying the current by the resistance of half the ring, and finds that the potential difference is 1/40 volt, but on being asked which of the two points is at the higher potential, his faith in this result is completely shaken, and it generally dawns on him that all points of the ring must be at the same potential. The current flows, not because of any differences of potential, but because of the induced electromotive force. Surely this is a case of electromagnetic induction, No. 1,322 notwithstanding.

Although, strictly speaking, the potential theory is not applicable to the case considered, this example shows very clearly that, in the ordinary sense of the term, *potential difference* is by no means essential to the production of a current of electricity, but *electromotive force* is always essential. As a matter of fact, the electromotive force around any circuit is simply the work done in moving unit quantity of electricity around the circuit.

I do not propose to go any further with this detailed criticism of the glossary: I think that I have gone far enough to show that there is something radically wrong with what I regard as the most important section of it: in my opinion the

definition of a lampholder or of a boiling plate is a minor matter compared with the correct definition of the fundamental conceptions upon which all electrical measurement is based. In making these adverse criticisms, I do not wish to undervalue in any way the services of those who have devoted much time and trouble to the preparation of this volume.

I would suggest, first, that the B.E.S.A. should withdraw the volume from publication until it has been thoroughly revised; and, secondly, that it should issue a notice asking those who have already purchased a copy to delete pages 11 to 18 pending their revision.

Discussion.

Mr. C. C. WHARTON (member of the Editing Committee of the B.E.S.A.) said that many of the definitions referred to in the paper were in the nature of conventions, and should have been pretty well thrashed out by now; but apparently they were not so clear as they might be, and the B.E.S.A. was glad to have such a clear expression of opinion. The Editing Committee had had to do the best it could with the definitions submitted; they were drafted by sub-panels of the Sub-Committee on Nomenclature, there being about 11 sub-panels dealing with particular sections of the industry. Where the Committee found discrepancies, they were referred back to the sub-panels concerned. He submitted that that was not a suitable place at which to deal with the detailed suggestions made in the paper; it was a matter for the professors to thrash out among themselves.

Sir JOHN SNELL (President of the Section) said that a very distinguished professor had criticised certain fundamental definitions, upon which the whole structure of electricity depended. Although he agreed with Mr. Wharton that the meeting was not an occasion for him to defend the Glossary, there were present a number of professors in electricity, and it was an occasion for those who were competent to do so to discuss, and agree upon if they could, the points raised in the paper.

Professor C. F. JENKIN suggested that very small alterations in words would in many cases put the matter right. For instance, the insertion of the words " in vacuo " would make many of the definitions clear.

Mr. P. GOOD (B.E.S.A.) said that the difficulty in replying to the points raised by Prof. Howe was that the terms and definitions used in the Glossary had been prepared by a number of people, none of whom were aware of Prof. Howe's paper until 10 or 12 days before the meeting, and they had been unable to attend. Undoubtedly one or two small editorial changes were necessary; with regard to the main challenge, however, clearly there was room for discussion, as there existed wide differences of opinion. Professor C. L. Fortescue certainly did not agree with a good deal of what Professor Howe had said, and had prepared a written comment in reply. In the course of this, reference was made to Professor Howe's statement that there was serious confusion between the electric and magnetic forces, and the results of those forces. A complete answer to those criticisms, it was stated, would require a long paper, but, put briefly, the situation was as follows:—The field strengths were defined in terms of the unit quantities; " lines of force " were easily drawn and enclosed " tubes of force "; those tubes of force were supposed to indicate the distribution of " displacement " or " induction "; but whatever those were, they could be measured in only one way, *viz.*, by the surface integral of the normal field strength over an area of cross-section of the tube. There was thus only one definite distinction between field strength and " tube of force " or " tube of induction," *viz.*, one was measured by the mechanical force per unit charge at the point in question, whereas the other was the surface integral of the field strength. It mattered not what mental pictures of " displacement " or " induction " were formed; in the end those two definitions were the basis of the whole theory. Maxwell used the term " displacement," but guarded himself and carefully pointed out that the only underlying assumption in his theory was that rate of change of " displacement," " number of unit tubes," " electric flux "—call it what they would—was equivalent magnetically to a current. The modern conceptions of the constitution of the atom also demanded that the electric and magnetic fields in all media should be phenomena associated with what was generally known as the aether. The classical theory required that the " displacement " or " induction " in a vacuum should be the same as the flux, and as far as modern knowledge went they were always the same. Faraday's experiment showed that electromotive forces were induced quite independently of whether the magnetic flux was in air—which was practically equivalent to a vacuum—or in any other medium.

The definitions had, therefore, been so worded that they were not incompatible with these views. The only definition that could be regarded as in any way different from the classical ones was No. 1307. Professor Howe would presumably prefer " tubes of induction," but whatever " induction " might be, the tubes could only be measured as tubes of force, and the definition must, therefore, be regarded as a reasonable —and he thought preferable—alternative.

Sir JOHN SNELL said that the Committee of Section G had recommended the appointment of a Committee to deal with the question of electrical definitions and terms, and that that Committee had been approved by the General Committee of the British Association. Therefore, he asked Mr. Good to hand Professor Fortescue's criticisms of Professor Howe's paper to that Committee, which would confer with the Committee of the B.E.S.A.—if the latter would consent to that course—in order that some agreement might be reached.

Professor F. G. BAILY associated himself with Professor Howe's remarks. He agreed that the fundamental conceptions of cause and effect were different things and should be separated, and could not be used indiscriminately. That was the basis of a lot of Professor Howe's criticism. Some 14 or 15 years ago the International Electrotechnical Commission had done exactly the same thing as the B.E.S.A. had now done, and that had led him to criticise its definitions.

Professor W. CRAMP (Birmingham) said he could quote 15 definitions in the first section of the Glossary, other than those quoted by Professor Howe, which in his view were hopelessly wrong. However, Professor Howe had certainly hit upon the pick of the bunch. The point he wished particularly to emphasise was that, in describing a tube of force and tube of flux as the same or similar things, the B.E.S.A. had made a fundamental blunder. Every cubic centimetre of magnetic material contained energy when magnetised, and that energy could be divided into a quantity component and an intensity component. The B.E.S.A. said that the two were the same thing; it was, however, not only a question of the units, but of the fundamental ideas underlying energy. With regard to No. 1315, " Magnetising Force," the B.E.S.A. had attempted to distinguish between magnetic force due to a permanent magnet and that due to a solenoid. The former it called " Magnetic Force," and the latter " Magnetising Force." The remarks of Professor Howe with regard to No. 1207, " Unit Electrostatic Tube of Force," were true, with one exception. He had stated that it was not the usual convention to take one tube of force as corresponding to one electrostatic unit of quantity. It all depended, however, upon what was meant by " usual." If one referred to standard works by physicists, as, for instance, J. J. Thomson and Clerk Maxwell, one would find that they expressed electrostatic work in terms of Faraday tubes. The Faraday tube was a tube of force such that at either end of the tube there was one electrostatic unit of quantity. That was the definition given by the authors mentioned, and it would fall under the B.E.S.A. explanation of this quantity, and the B.E.S.A. had actually mentioned the Faraday tube as one of the alternatives. It could not be too clearly understood that there was confusion between Maxwell tubes and Faraday tubes. Professor Howe had been teaching, evidently, on the Maxwell tube, but nine out of ten of the text-books dealt with Faraday tubes, and the other one-tenth muddled them up. Dr. Wall's text-book started with Maxwell tubes for electrostatic work, but half-way through the book, without warning, he changed over to Faraday tubes. While he (Professor Cramp) felt that Professor Howe was right in his statement, they must have a clear idea as to whether to follow the physicists or the engineers in this particular matter—and that dragged in the " King Charles's head " of the 4π. As to the suggestion by Mr. Wharton that the professors must thrash out between them the detailed matters raised in the paper, he asked why they were not given the opportunity to do so before the Glossary was published, instead of afterwards. They had no idea that the volume was approaching publication, and it was not reasonable to publish such a volume without reference to those who were teaching.

Sir HENRY FOWLER pointed out that the present position was a difficult one, as those responsible for the Glossary had not had an opportunity of dealing with the criticisms.

Mr. F. S. BARTON agreed that the Glossary should have been referred to eminent members of the teaching profession connected with engineering. As a physicist, he regarded the state of affairs put forward by Professor Howe as really alarming. The matter was one upon which some of the older physicists should be consulted, in order that there might be some agreement between them and members of the electrical engineering profession, and he thanked Professor Howe very heartily for having brought it forward.

Professor HOWE, replying to the discussion, agreed that the time given the B.E.S.A. to deal with his criticisms had been very short. The Glossary dealt with things he had been troubling himself about for 25 years, and had tried to crystallise for teaching; he had found that the definitions ran counter to the scheme he had been teaching for years, and the whole structure of his teaching was carried away by them absolutely.

As to the suggestion made by Professor Jenkin, he did not think the insertion of the words " in vacuo " would have put things right.

He agreed with Professor Cramp that there was some confusion between Faraday tubes and Maxwell tubes; it was preferable to talk about a tube of flux or a tube of force, than to use either name. When writing the paper he had referred to one or two modern books on elementary physics, and found that the subject was treated in the same way as it was treated in electrical engineering. The 4π question was a very debatable one. If the panel of the B.E.S.A. which was responsible for the Glossary had said point blank that it would try to get rid of the 4π and to adopt another system of units, he would have had nothing to say. Although it had been suggested, and was in some ways preferable, it was not the usual convention among the great majority of electrical engineers to use the system of 4π for lines of force emanating from unit charge.

Instruments for Refrigerating Installations Aboard Ship.

In the course of a paper communicated by the Engineering Committee of the Food Investigation Board of the Department of Scientific and Industrial Research, and read by Dr. Ezer Griffiths (of the N.P.L.) in Section G (Engineering), on the

investigation of refrigerating installations on board ship, reference was made to the importance of studying the various forms of instruments used under marine conditions. As a result of the investigations carried out, two general conclusions were arrived at, namely, (1) the inadvisability of making a delicate element such as a moving coil, an integral component of an instrument contained in a heavy gun-metal or iron case. A substantial case was desirable, but the delicate element should be removable for separate transit; (2) the need for clearly worded instructional manuals to accompany each instrument. Data sheets should be permanently fixed inside the lids of instruments.

In describing a robust form of resistance thermometer which had been evolved, the author said experience had shown that ordinarily the porcelain former on which the wire was wound to constitute the bobbin of the resistance thermometer was somewhat fragile, and breakages were frequent. A rugged form of thermometer had been devised, and, on account of the heavier wire used in its construction, it was permissible to use a less sensitive moving-coil indicator, for the sensitivity was determined by the current employed in the circuit, and the magnitude of that current was limited by its heating effect on the thermometer. A design was shown in which the coil was not wound on a bobbin, but was laid flat between two sheets of mica, fixed with bakelite; that unit was then inserted into a brass tube and cemented by a film of bakelite to the inner surface of the tube. That method of construction had the additional advantage of giving a thermometer possessing a very small time lag. The comparative tests made between that thermometer and one of the standard commercial forms showed that its time lag was only of the order of one-half that of the other. The heating effect of the current on the thermometer was small, because both surfaces of the coil were subject to the cooling effect of the atmosphere. To obtain quantitative data as to this, tests were made to determine the constant κ in the formula $d_R = \kappa C^2 R$ where d_R was the increment in the resistance due to a current C. For the new design, $\kappa = 0.027$; for the commercial form, $\kappa = 0.045$. Hence, under identical conditions, the heating effect was reduced in the proportion of 0.045 to 0.027, *i.e.*, 1.7 to 1.

The following data as to the constancy of the resistance of the thermometer after various heat treatments were given: After annealing, the resistance at 0 deg. C. was 15.077 ohms. Four months later it was 15.081 ohms. The thermometer was then immersed in liquid air, so that its temperature was reduced to about −180 deg. C. The resistance at 0 deg. C. was then 15.082 ohms. All those variations were within the limits of experimental error.

New Electrical Devices, Fittings and Plant.

(Readers are invited to submit particulars of new or improved devices and apparatus.)

A New Cable-Sealing and Joint Box.

A new design of cable-end sealing and joint box has recently been introduced by Mr. GEORGE ELLISON, Perry Barr, Birmingham. It has been developed for colliery cableways, for use on 3-core armoured cables, and is designed specially for the convenient jointing of lengths of cable in advancing roads. It is made in two sections, each of which constitutes the cable-end sealing box, fig. 1. This is a strong casting, fitted with an Ellison patent cone clamp for armoured cable, and containing a set of three terminal posts for the cable cores. Soldering is avoided by the use of shell clamps on the terminals, and the box is closed by a slab of "Tufnol" (synthetic-resin-paper) through which the terminal posts project to take coupling links as referred to below. A cast-iron lid gives protection to the projecting studs and renders the device suitable for the rough usage of a coal mine. An earth terminal is fitted to the side of the box, to take the earth core of the cable on the inside and a bonding connector on the outside. The joint box, fig. 2, consists of the two end boxes bolted together with the terminals connected by copper links, the boxes being suitably bonded. One cast-iron lid in this case covers both boxes. The sealing box is intended to be filled solid up to the "Tufnol" cover with compound and then hung or laid in any position. It is claimed that there is no risk of the compound leaking out when warm. This device should prove of value in cases where cable ends are left "open" temporarily with a view to extension at a later date.

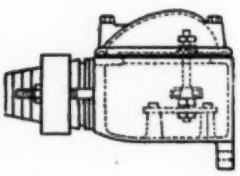


Fig. 1.—Sealing Box.

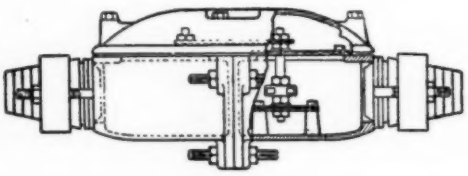


Fig. 2.—Joint Box.

A New Cable Gland.

We have received from MESSRS. GEORGE H. SCHOLES & CO., LTD., Blantyre Street, Chester Road, Manchester, some particulars of their latest production, the "Wylex" two-piece gland for bonding armoured cables to all types of cable boxes. Fig. 4 shows the device in section. The base is screwed in the usual way direct to the box, and a cap in turn screws on to the base, leaving a chamber between the base and cap. This is filled with a special resilient conducting compound which is compressed on tightening the cap in a manner similar to the packing in a pump plunger gland. The compound squeezes into the interstices of the armour wires and, it is claimed, efficiently bonds the cable, at the same time making a perfectly watertight joint.

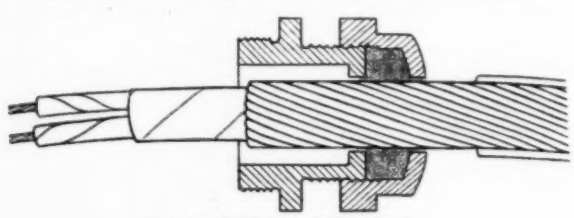


Fig. 4.—Self-Bonding Cable Gland.

An Electric Wood-marking Machine.

An electrically-heated press for burning brands or firms' names on wood has recently been put on the market by M. Aug. Demblon, 16, Rue Gerard, Belgium. The apparatus, which is known as the "Ada," is a small hand-operated machine, and the branding die is made of copper or steel, and is provided with a heating element known as "Adaritherme," which is connected up to any source of electrical energy at any pressure up to 220 V. The counterpart of the die is made of a special alloy known as "Thermaline," which, it is claimed, will attain the requisite heat in a minimum of time. The machine is adapted to take dies up to a size of 62 sq. in., for which the power consumption is stated to be 1 kw.

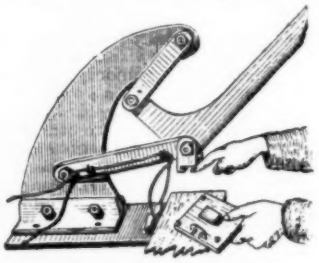


Fig. 3.—Electrical Wood Brander.

Small Single-phase Motor.

MESSRS. HIGGS MOTORS, Witton, Birmingham, have recently introduced a range of single-phase squirrel-cage motors, fig. 5, for installation where a small power output is required. These motors, which cover a range of from ¼ to 2 h.p., are fitted with twinob switches and ball bearings. These machines can also be supplied with high torque rotors, when they will develop 60 per cent. of the full-load torque at starting with about four times the full-load current. Simple external connections are arranged for in specially provided terminal boxes.

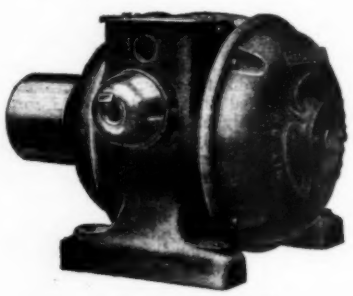


Fig. 5.—Small Single-phase Motor.

A New Oil-break Switch.

The accompanying illustration, fig. 6, is of a new design of oil-break switch, which has been recently introduced by MESSRS. HEYES & CO., LTD., Water-Heyes Electrical Works, Wigan. It is a triple-pole switch, fitted with three overload trip coils, and is designed for small working capacities on pressures up to 600 V. It is equipped with a flameproof

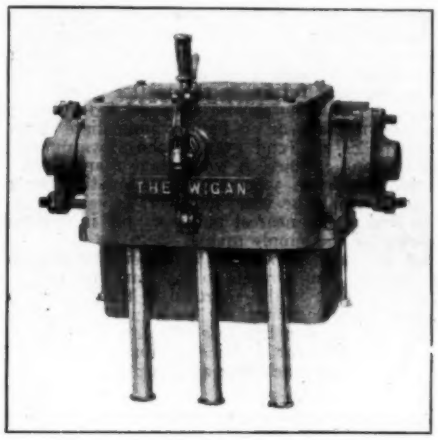


Fig. 6.—600-V Oil-Break Switch.

breather in the oil tank to allow for the escape of any generated vapour. All the flanges are machine faced, and the apparatus is suitable for fitting with armour glands, with or without sealing boxes, or screwed tubing for the cable inlets and outlets. A d.p. switch is also made; this is fitted with only one overload trip coil.

A Cable-Coiling Device.

We have received from Mr. A. W. SAULTER, 240, Lower Road, S.E.8, a copy of the patent specification for a cable-coiling apparatus which he has recently invented and patented. The object of the device is to obviate the disadvantage of the ordinary coil of house-wiring cable, *viz.*, the difficulty of unwinding the cable without getting it entangled. It consists of two blank pieces of cardboard or similar material, spaced apart with their planes parallel by a centrally fixed spindle. The

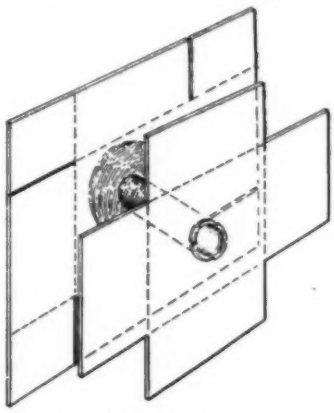


Fig. 7.—Cable-Coiling Apparatus.

wire is wound on the spindle, the cardboards acting as flanges to keep the wire in position. Cuts in the cardboard enable it to be folded over the wound wire in the form of a box in which manner it can be dispatched, stored and marketed. This should prove a particularly useful device and time saver for the wireman, who, apparently, would always be able to keep his part-used coil in the packed condition. Fig. 7 shows the equipment in the unfolded position.

An Insulator Testing Machine.

Some particulars are given in the *Electrical World* of a testing machine which simulates the conditions to which an insulator in service on a transmission line is exposed. It has been constructed in the Oregon State Agricultural College electrical engineering laboratory for use in insulator testing. The novel feature of the machine is that it is so constructed that mechanical load and electrical potential can be applied to the specimen simultaneously. A mechanical load of 50,000 lb. can be obtained by means of a ram operated by oil from a h.p. pump. Electrical pressure up to 500,000 V can be applied to the test specimens when placed on the machine. Combined mechanical-electrical tests are made by applying mechanical tension, in increments of 2,000 lb. per min., while a constant voltage, 25 per cent. below flash-over point, is maintained. The point at which a specimen fails, either electrically or mechanically, is the ultimate service strength of the insulator.

Safety-in-Mines Research Board.

Fourth Annual Report.

WE have received a copy of the fourth annual report, 1925, of the Safety-in-Mines Research Board, which covers the activities of the Department for the 12 months ended March 31st last. The expenditure during that period amounted to £63,900, of which £19,300 was capital expenditure for the new experimental station and explosion gallery at Buxton. It was expected that the new building would be ready for research activities in July of this year. A site adjoining the University at Sheffield has also been obtained for another station, which will accommodate the Fuel Research Board's survey of the seams of the Yorkshire coalfield. Work on the construction of flame-proof electrical machinery has been continued, in collaboration with the Mining Department of Sheffield University and the British Electrical and Allied Industries Research Association. The research on the construction of flame-proof plug and socket contacts, referred to in the last report, has been completed by Mr. H. Rainford. The electrical researches are divided into two groups. One group deals with the use of electricity for signalling, telephoning and shot firing, and the other with the general phenomena associated with its use. The use of wireless for underground communication is being studied under the first group, but insufficient information is at present available to enable the board to decide whether an instrument suitable for use in coal-mining could be designed. The work on electrical exploders for shot firing has been continued as far as is deemed necessary, and a report on the subject has been published (Safety in Mines Research Board Paper No. 11, "Electrical Exploders for Shot-firing in Coal Mines").

Experimental work on the electric charges generated on particles of coal dust when they are whirled in air has been continued, and the electric charges generated on equal weights of different coal dusts, and the weights of each coal dust required to cause given potential differences have been measured with a view to the correlation of the inflammability of a coal dust with the electrical phenomena associated with it. With one particular dust the charge recorded by the voltmeter was approximately 6,000 V, and with pressures of this order there seemed to be a possibility that the self-electrification of coal-dust particles would result in a spark discharge capable of igniting a fire-damp air mixture. In connection with the work on inductance sparks as a means of ignition of gases, attention has been confined to a comparison of the igniting power of inductance sparks when produced by a.c. and d.c. In order to find what pressures are produced by the striking of momentary arcs in closed vessels, electric arcs have been initiated in a closed brass vessel by the separation of two electrodes carrying currents up to 180 A with both d.c. and a.c. The highest pressure obtained was 13 lb. per sq. in., when the arc was formed by the separation of electrodes carrying 140 A, d.c. With a.c., no pressure was recorded with the same current. Research in finding the pressures produced by the vaporisation of fuses in cut-outs, has shown that when a sufficient current is passed through the wire to fuse it, an arc is produced at the moment when the actual fusion occurs and the pressure inside the box is raised, partly on account of the increase in temperature of the air contained in it, but mainly by the vaporisation of the metal. With a.c. very low pressures were produced and oscillograph records indicated that the maximum duration of the arc was half a cycle (0.01 second). Progress has been made with the construction of an electrical fire-damp detector, and a device which appears to answer all the requirements of a practical fire-damp detector or "tell-tale" has been designed and subjected to test. Work in the construction of an electrical fire-damp estimator has proved difficult and the research has been slow and disappointing.

An appendix gives a report on the co-operative research between the United States Bureau of Mines and the Safety in Mines Research Board during 1925.

The Report may be obtained from H.M. Stationery Office, price, 1s. net.

Large Synchronous Condensers.—The *Electrical World* states that synchronous condensers said to be of greater capacity than any ever previously built have been ordered by the Southern California Edison Company for regulating the voltage along the transmission lines which carry electrical energy from remote hydro-electric developments into Los Angeles. Each of the three condensers, which are being built by the General Electric Company, is rated at 50,000 kVA, 13,200 V, 50 cycles, 600 r.p.m. Two are to be installed in the new Lighthipe sub-station and the other in the Eagle Rock sub-station. The largest synchronous condensers previously constructed by the General Electric Company have a capacity of 30,000 kW each and are in use in the Laguna Bell and Fagle Rock sub-stations of the Southern California Edison Company. For each condenser the manufacturing company is supplying three transformers. These are of 16,700 kVA rating, and have 73,000-V primary and 13,00[illegible]-V secondary winding.

Electricity in Poultry Farms.

By R. BORLASE MATTHEWS, Wh Ex., A M.Inst.C.E., M.I.E.E., F.R.Ae.S.

(Abstract of a paper read at the Harper Adams Poultry Conference.)

In all branches of industry to-day there is the keen desire to lower the cost of production and yet maintain a high state of efficiency. This is as true in the poultry world as it is in the factory. The engineer has contributed his quota to the efficiency of the present day industrial sphere, and the paper shows how the engineer can come to the aid of the poultry farmer.

While electricity can be utilised conveniently for all forms of power, it perhaps appeals most to the poultry farmer, as a means of lighting the laying house, the brooder house, and the incubator room. A very promising field for the use of electricity is the application of ultra-violet rays to hens and chicks. Tests with a mercury-vapour lamp were recently carried out at the Agricultural College of Wisconsin, with the result that hens subjected to a ten-minute ultra-violet radiation per day laid considerably more eggs than birds living under exactly similar conditions without ultra-violet treatment. The most advantageous period to apply the treatment seems to be from December to March, when chicks suffer from lack of sunlight. Two other electrical treatments which have been given to young chicks with remarkable success, but not on a commercial basis, are the operation of ozone-generating apparatus in the brooder house, under which the chickens also seem to thrive better than is usual, and the maintenance of a high-pressure charge on a wire or wires placed over the chicks, similar to electro-culture as applied to plants.

The use of electric lighting for increasing egg production during the winter months has proved to be one of the most important commercial innovations introduced into the poultry world during recent years. It has now long passed the experimental stage. The correct light intensity on the floor has been found to be from 0.8 to 1.0 foot-candle. It sometimes happens that although there is sufficient light on the floor, the lack of any direct light on the perches results in a number of birds failing to come down to feed.

The method recommended for running the lighting wires in the poultry house is by fixing them at intervals with cleats, in the case of v.i.r. cables, or clipping them direct to boards or beams where metal or rubber-sheathed cable is used. With the "Selfix" outfit any poultryman can complete an electrical installation which will meet the requirements of any fire insurance office and of the local electricity supply undertaking. While any standard accessories may be employed, the most suitable ceiling roses will be found to be those of the detachable pattern. The types of reflectors found by the author to be suitable for poultry houses are the vitreous-enamelled dispersive type, the vitreous-enamelled extensive or deep-bowl type, the glass industrial prismatic type, and the plain conical sheet-metal reflector with an aluminium-paint reflecting surface.

A practical recommendation for the lighting of most poultry houses is the use of 40-W vacuum-type lamps in extensive-pattern reflectors. The lamps should be spaced about 10 ft. apart and placed about 6 ft. from the ground. Determining the position of these lamps is comparatively simple; what has to be borne in mind is that as far as possible there should be an equal intensity over the feeding space.

The poultry farmer should consider how he is going to turn the lights on and off, and as regularity is an all-important matter the switching operations should not be dependent on the time-keeping of any workman. Many birds fall into an early moult if subjected to irregular hours of lighting. Before selecting an automatic time switch, the programme of lighting must be decided upon. This will depend partly upon the poultry farmer's convenience and arrangements; partly on the breed of the birds; and partly on local circumstances, such as the prevalence or otherwise of rats and the charges for electricity. Experience has proved that it is better for the birds to switch on a dim light in hours of darkness before a full one, and also to dim before switching off, so as to allow the birds time to get on their perches. The author employs a clock which winds itself electrically, and, by means of an astronomical attachment, automatically follows the rising and setting of the sun for switching off and on. For morning and evening lighting, coupled with automatic dimming, the author has employed two cheap-pattern clock switches.

As poultry houses are usually situated some distance apart, the cheapest and most convenient way to distribute electricity to them is by means of overhead wires. The wire can be mounted on old telephone insulators. It should be strained in position in the usual manner adopted for erecting wire fences. Any sort of poles will serve, but they should keep the wires twelve feet above the ground or six feet above the buildings. The two wires should be kept 16 in. apart. To the tops of the poles and over the current-conveying wires an insulated galvanised steel wire should be attached, to protect the lines from lightning. On each pole another galvanised wire should be stapled lengthwise, leaving six inches to project at the top and a couple of feet for earthing at the ground end.

Automatic controls are not needed for mercury vapour or arc lamps for ultra-violet treatment, as each application should not exceed ten minutes or so. This permits of the home constructed lamp or preferably the adaptation of a magic-lantern arc.

For high-pressure electrification the distribution is best attained by means of very fine aeroplane steel wire (No. 29 gauge) stretched through the brooder house. This wire can be slung on a chain of four wireless-type butterfly insulators The electrical charge can be obtained from a 10-in. medical or X-ray coil, or, if an a.c. supply is available, from a transformer and a synchronous electric motor rectifier of the Newton-Wright type. Large wireless valves can also be used for rectification.

Unfortunately there is only a fraction of the poultry farmers of this country in the happy position of being able to obtain a public supply. Though there are signs that something will be done in the near future, in the matter of electrifying the rural areas, it would be unwise to count too much on this, as there does not appear to be any immediate prospect of general electrification, and even if the Government scheme were put in hand at once, it would take many years to complete the task. Those who are contemplating installing a generating set would be wise, however, in selecting a voltage similar to that of the nearest public supply in anticipation of the extension of the supply mains.

It is not generally known that a farmer who owns his land, or, if a tenant can arrange to pay an increased rent to his landlord, subject to the approval of the Ministry of Agriculture, can borrow money for such purposes as installing an electrical plant, at a low rate of interest. A loan of £500 for 20 years (the limit for electrical equipment) costs £7 12s. 9d per £100 per annum, including all charges.

Legal.

Non-Payment of Employés' Insurance.

At Bradford Police Court, on August 19th, Richard Lindley, junr., electrician, of Shipley, was fined a total of £12, with costs, for failing to pay National Unemployment Insurance contributions in respect of four employés. It was stated that in two cases no contributions had been paid for some time, although the men's share of the contributions had been deducted from their wages. It was also found that in respect of a man employed since January, 1923, and another employed since January of this year, no contributions for unemployment had been paid since their engagement. Defendant said that the default was due to carelessness, and offered to pay the money in full; there had been no intention to defraud.

Sussex Electricity Supply Co., Ltd., Sued.

In the Arundel County Court, on August 13th, before Judge Moore Cann, Edward and Beatrice Martin, Littlehampton, sued the Sussex Electricity Supply Co., Ltd., for £4 17s., damage alleged to have been caused by the company's employés while wiring the plaintiffs' premises. It was stated that the sum sued for was incurred in putting the house in order after the wiring had been done. For the defence it was contended that it was not the practice of electricians to make good after the wiring was completed, and particularly it was not done in this case owing to an understanding that the house was to be redecorated. His Honour gave judgment for plaintiffs for the sum claimed with costs.

Embezzlement Charge.

At Leeds, on August 21st, Owen Parker Swift (53), whose address was given as Ararat Road, Richmond, Surrey, was remanded on a charge of embezzlement of moneys belonging to Electrolux, Ltd., Briggate, Leeds, by whom he had been employed as a travelling salesman of electric vacuum cleaners. It was stated that he disappeared suddenly early in July and it was found that he had collected two sums of £15 17s. 6d., for which he had not accounted.

British Thomson-Houston Litigation.

In the Vacation Court on August 18th, Mr. Justice Fraser had before him an action by the plaintiffs against H. Walker and Co., on a motion to restrain the defendants from infringing two of plaintiffs' patents, *viz.*, the leading-in wire and the gas-filled lamp.

Mr. Geoffrey Tookey, for the plaintiffs, said that no appearance had been entered by the defendants and they were not represented in Court. His Lordship granted the injunction asked for.

An injunction was also granted in a motion by the same plaintiffs against the Expert Electric Fittings Co., Ltd., Mr. Tookey stating that it was a similar action to the previous one and that there was no appearance entered by the defendants.

Alleged Lamp Theft.

On August 17th, at Leeds, Edwin Elmes was charged with stealing 437 electric lamps valued at £70. It was stated that the defendant was formerly manager of the Leeds branch of the Tungsram Electric Lamp Works (Great Britain), Ltd. He was remanded.

Correspondence.

Correspondents should forward their communications **at the earliest possible moment.** *No letter can be published unless we have the writer's name and address in our possession.*

A Suggested Wireless Transmission Theory.

Referring to Mr. Barton's letter in your issue of August 20th, he will, I feel sure, find it a pleasure to read the address, delivered on December 11th, by Senatore G. Marconi as chairman of the Royal Society of Arts, and reported on page 932 of the ELECTRICAL REVIEW dated December 19th, 1924. In that address there is much valuable information concerning the transmission characteristics of long and short wave-lengths. The shorter wave-lengths are more efficient both by day and by night provided that the transmitting apparatus and its associated aerial system are specially designed for such wave-lengths.

It may prove helpful if I point out that the wireless transmission articles were framed so as to distinguish as completely as possible between the variations in efficiency occasioned by changes in aerial and apparatus design and those exclusively attributable to the characteristics of the media intervening between the transmitter and receiver. For instance, with a given wave-length, type of aerial, and aerial input, we have the plain spark, quenched spark, arc, and valve types of transmitter giving a more or less progressively better transmission range both by day and by night by reason of the better utilisation of the energy for the purpose in view. Further, on the aerial side there are—for a given type—variations in efficiency which depend upon whether the aerial is (i) transmitting near to its "natural" wave-length; (ii) "loaded" for a longer wave-length; (iii) "condensed" for a shorter wave-length; or (iv) tuned by means of the harmonic method. These and other similar factors are best considered apart from the theory of propagation, just as in the science of light the theory of propagation is largely considered apart from any specification of the relative efficiencies and other data concerning the various sources available for the production of light.

Chas. E. Snell.

London, *August 21st*, 1926.

Electric Resistance Furnaces.

With reference to Mr. Drake's letter in your last issue criticising Messrs. Anderson and Conley's article on "Resistance Furnaces," as this furnace was constructed by our licensees, and largely to our design, we are naturally interested in Mr. Drake's remarks.

As regards the specific heat of the metals at various temperatures, it is difficult to obtain any really reliable figure, but we agree that in the case of iron and mild steel the authors have been rather too optimistic.

With regard to the subject of heat insulation, if a furnace is required to be used continuously this should be of the very best material, and as thick as can be afforded, balancing capital cost against working cost. The furnace under review was, however, intended to be used for experimental runs only; it was, therefore, most important to attain a working temperature quickly, and for this reason the thickness of insulation was reduced to a minimum, consistent with the obtaining of sufficient mechanical strength.

On our standard furnaces, the heat losses are only about half those found by Messrs. Anderson and Conley on the demonstration model.

The writers of the article are to be congratulated on the pains taken over the investigation, which we realise must have occupied a considerable period. The article has aroused great interest, and should materially assist in further popularising industrial electric heating.

Automatic and Electric Furnaces, Ltd.
E. P. BARFIELD, *Managing Director.*

London, *August 23rd*, 1926.

A German Water Power Research Society.—Under the auspices of the German and Bavarian Governments and the Kaiser Wilhelm Society, a new water power utilisation Research Society has recently been formed in Germany. It is proposed to establish a special laboratory on the banks of Lake Walchen in Bavaria, where research work in connection with the economical utilisation of water power will be studied, including such questions as the effect of flowing water on river beds, the design of dams, the most suitable forms of canals, piping, and other conduits. The new association will have the advantage of making practical tests at the large and important hydro-electric station which has lately been completed on Lake Walchen. It is estimated that in Bavaria alone there is still about 2 million h.p. undeveloped, and with a similar amount available in other parts of Germany, it is estimated that by utilising this it would be possible to effect an economy in coal consumption of 20 million tons per year.

Reviews.

Electrical Insulating Materials.—By ALLAN MONKHOUSE. Pp. xvi+392; illustrated. London: Sir Isaac Pitman & Sons, Ltd. Price 21s. net.

The scarcity of good books dealing with electrical insulating materials is in itself a sign of our lack of knowledge of the subject. In comparison with the state of the art of other materials used in the manufacture of electrical machinery and apparatus, the subject of electrical insulating materials can hardly be considered to have advanced further than the Stone Age. Any reliable information on the subject of electrical insulating materials is most welcome. Mr. Monkhouse's work with the Metropolitan-Vickers Electrical Co., Ltd., and the very active part he has played on various committees of the Electrical Research Association, of London, place him in a unique position to record some of our present knowledge and lack of knowledge of this important subject. From the first page to the last, the author's task has been well done. In the preface, the author states that the scope of the book is "an endeavour to deal with all the insulating materials employed in modern electrical work, giving as much information as possible with regard to their prime source and the processes associated with their preliminary preparation and manufacture." The book is kept strictly to this scope as defined above, and places in the hands of those interested in the manufacture, use, or study of electrical insulating materials much information which heretofore has only been in the hands of insulating engineers and research associations. One of the most valuable features of Mr. Monkhouse's book is its strict adherence to the methods of test recommended by the Electrical Research Association. The values given in the tables, &c., are, wherever possible, values obtained by the E.R.A. test methods, and where tests have been published by the E.R.A., they are reproduced in full in the appendix to the book. It is known that the E.R.A. has not as yet issued directions for methods of test on all classes of electrical insulating materials, and in such cases Mr. Monkhouse has rendered valuable service either by recording methods of test recommended by other bodies, or, where no recognised methods exist, by giving suggestions based on his own experience. It is safe to assume that these valuable suggestions have been tried by the organisation with which Mr. Monkhouse is connected, and it is hoped that the author's suggested methods of test will be tried by others so that the standardisation by the E.R.A. of methods of test will thus be hastened. The chapters dealing with the following materials are of special importance: Paper, treated fabrics, insulating varnishes, resins, press-board, timbers, bitumen, &c. Our present lack of knowledge of electrical insulating materials may, amongst other things, be traced to (*a*) ignorance on the part of electrical engineers of the technique of other industries supplying materials used for electrical insulation; (*b*) absence of standardisation in methods of test, which has rendered it impossible to compare test results obtained by various authorities. Mr. Monkhouse's book does much to remedy both of these troubles. Its extensive use as a book of reference throughout the electrical industry will do much to help forward this backward yet all-important subject of electrical insulating materials. The vastness of the subject prevents the author giving any consideration to the study of the factors which influence the electrical strength of insulating materials or to the problems associated with the use and design of insulation in electrical machinery and apparatus. It is to be hoped that the author will later supplement his valuable contribution by a companion volume dealing with some of these other phases of electrical insulating materials. In the next edition of the book now under review, it is hoped that the author will be able to include a far larger number of illustrations. Additional sketches and photographs of the materials dealt with and processes described would add considerably to the value of the book.

Signal Wiring. By TERRELL CROFT, M.A.I.E.E., Consulting Engineer. Pp. xii + 349; figs. 463. London: The McGraw-Hill Publishing Co., Ltd. Price 15s.

A book which deals with any phase of electrical engineering in a novel manner or which deals with a comparatively neglected branch of the subject is always of interest; in the volume under notice we have an extremely practical treatment of weak-current circuits for signalling purposes of all kinds, and the result is worthy of the attention of all engineers.

The work for the most part consists of diagrams of circuits, the author rightly considering that if these are well drawn little explanation is necessary. Diagrams and data supplied by firms engaged in the production of signalling apparatus have been largely drawn upon, but the author has very ably avoided the risk of making a mere compilation by suitably classifying the circuits and by including only diagrams of a really informative nature. It is not possible to indicate fully the very varied contents of the book in a short review but, in addition to bell circuits of usual kinds, we find such matters as burglar alarms, fire alarms, watchman and police call circuits, telephone circuits and mine, lift and power station signalling circuits, comprehensively described. In addition, a number of special alarm circuits are included, and sections are devoted to the construction of appliances for use on signalling circuits and to the details of the installation of such circuits. A feature of the book worthy of particular commendation lies in the many suggestions made for the employment of extremely simple, and often-

times home made, devices for the detection and notification of untoward conditions.

The numerous illustrations are well drawn and reproduced, and the book can be heartily recommended for inclusion in the library of every installation engineer. It will also be of great service to all who have problems concerning signalling arising in a subsidiary manner in connection with their main activities; students, also, will have their views broadened by a perusal of the book.

The Lead Storage Battery. By H. G. BROWN, A.M.I.E.E. Second Edition, 1926. Pp. 186; figs. 96. London: The Locomotive Publishing Co., Ltd. Price 5s. net.

This book will be useful in calling attention to many points which should be considered in the design and the construction of lead storage batteries, and affords a concise account of the rudiments of the subject. The volume under review, without being a specialist treatise, traverses the field of the technology of stationary and portable cells, but for a more complete treatment of the matters dealt with, more recondite works must be consulted. After an introductory chapter dealing with the chemistry of the lead cell, the subsequent chapters deal with electrical characteristics, erection and arrangement of stationary batteries, battery systems, battery economics, portable cells, and an appendix dealing with the ionic theory and the testing of the acid and water used in cells.

In books dealing with storage batteries, there is scope for considerable variety of treatment, differences proper to the requirements and attainments of different readers. Mr. Brown has written this volume in direct style and presents the facts in a readable manner. Possibly a little more attention might have been given to the more theoretical aspects of the construction and operation of batteries.

In fairness to the author it may be said that in this book there is to be found a certain amount of information which perhaps cannot readily be obtained without reference to somewhat inaccessible publications, and in the hands of an experienced worker the book may have a limited sphere of usefulness. It should prove of service to the student not greatly advanced in his studies and to others who desire a statement of the elementary principles of the storage battery. The volume is interesting and reasonably complete and the main body of the book is, within its limits, well written.

Electro Craft in Theory and Practice. By LEON H. BAXTER. Pp. 168; figs. 61. London: B. T. Batsford, Ltd. Price 7s. 6d. net.

This book has been written primarily for the benefit of the boy, presumably of the upper standard elementary class, who is eager to solve the problems with which the ordinary everyday domestic use of electricity confronts him. Something of the history of electricity is given, and the reader will find the more commonplace theories of electricity outlined. The elementary principles of the subject are dealt with in a most interesting manner, and much of the technique could only be introduced to such young students by means of the simple explanations which the author uses. The use of technical terms is not avoided, and simple formulæ are introduced; but the work will not suffer on this account because of the simplicity already referred to. Workshop practice in connection with electric wiring, introducing many practical problems, is dealt with at great length, and is fully illustrated. Considerable attention is given to the construction of such simple apparatus as electric toasters. Telegraphy and wireless are among the other subjects dealt with.

Trade-Mark Applications.

THE following are among the recent applications for British trade marks. Objections to any of the proposed marks may be entered within one month from August 18th. In the case of foreign applications, the names and addresses of the British representatives are also given:—

Ortho-Sonic (lettering and design). No. 468,912. Class 8. Radio transmitting and receiving apparatus and parts thereof.—Federal Radio Corporation, Buffalo, Erie, U.S.A. (Marks & Clerk, 57-58, Lincoln's Inn Fields, W.C.2.)

Metal T.M. (lettering and design). No. 470,195 and No. 470,196. Class 8. Instruments and apparatus for use in radio-telegraphy and telephony.—F. J. Markie, 83, Alberta Road, Bush Hill Park, Enfield.

Elstrodyne, No. 470,240, and Elstrophone, No. 470,243. Class 8. Valves and apparatus for use in radio-telegraphy and telephony.—Radio Press Service Department, Ltd., Bush House, Strand, W.C.2.

Raytheon (lettering and design). No. 470,286. Class 8. Rectifying tubes for use in radio-telegraphy and telephony and for other electrical purposes.—Raytheon Manufacturing Co., Cambridge, Mass., U.S.A. (Marks & Clerk, 57-58, Lincoln's Inn Fields, W.C.2.)

Uniflex. No. 470,614. Class 8. Apparatus for use in connection with radio-telegraphy and telephony, but not including amplifiers or any goods of a like kind.—J. Evans, trading as the Liverpool Radio Supplies, 64, Myrtle Street, Liverpool.

Dorcam. No. 470,989. Class 8. Horns for radio-receiving instruments.—S. F. McCord, Glencorse, Ridgeway, Long Ashton, Bristol.

Ortona. No. 471,094. Class 8. Loud speaker horns, loud speakers, &c.—A. Harton, Clarks Croft, Ferngrove, Bury, Lancs.

Trimic. No. 471,180. All goods in Class 8.—L. McMichael, Ltd.

Ducer. No. 470,776. All goods in Class 18.—Electroducer, Ltd., 324, Upper Street, Islington, N.1.

Cumulus. No. 471,026. Class 18. Electrically-heated water accumulators, and other electrically-heated water apparatus.—Die Fabrik Electr. Apparate Fr. Sauter Gesellschaft, Basle, Switzerland. (Abel & Imray, 30, Southampton Buildings, W.C.2.)

EMB (lettering and design). No. 467,970. Class 22. Bogies and under trucks for tramway and like vehicles.—The Electro-Mechanical Brake Co., Ltd.

Published Specifications.

Compiled expressly for this journal by Patent Agents
The name of the applicant's patent agent, if any, will be found on the printed specification.
The numbers in parentheses are those under which the specification will be printed and abridged, and all subsequent proceedings will be taken.

1925.

8,455. "Automatic or semi-automatic telephone systems." Standard Telephones and Cables, Ltd. (formerly Western Electric Co., Ltd.), and E. P. G. Wright. March 30th, 1925. (255,917.)

8,518. "Electrical distributors for internal-combustion engines." M. M. Ward. March 31st, 1925. (255,918.)

8,816. "Automatic control of the field circuit of alternating-current dynamos in railway train heating installations." J. Stone & Co., Ltd., and A. E. Honey. April 2nd, 1925. (255,920.)

10,987. "Electric heating device for burning and drying purposes." W. Cooper. April 28th, 1925. (255,930.)

11,096. "Elevator systems and apparatus in connection therewith." F. Lane and W. A. Machin. (Addition to 254,429.) April 29th, 1925. (255,939.)

11,176. "Thermally-actuated electric switches." E. G. Nicholson. April 29th, 1925. (255,942.)

11,179. "Directive aerials." L. Levy. April 29th, 1924. (233,346.)

11,209. "Jointing devices for electric leads." T. R. Overton. April 29th, 1925. (255,944.)

11,661. "Electric batteries." British Thomson-Houston Co., Ltd., and H. W. H. Warren. May 5th, 1925. (255,967.)

11,770. "Electric couplings or connectors." Peranne & Co., Ltd., and J. B. A. E. Peranne. May 6th, 1925. (255,969.)

11,927. "Head lights." J. Stoddart. May 7th, 1925. (255,972.)

12,010. "Wander plugs or terminals for batteries or for similar purposes." J. J. Rowe. May 8th, 1925. (255,974.)

12,111. "Sound-reproducing apparatus." "Ira" Internationaler Radiovertrieb Ges. February 23rd, 1925. (247,902.)

12,250. "Temperature-controlling devices for electric furnaces." British Thomson-Houston Co., Ltd., and S. Payman. May 11th, 1925. (255,977.)

12,386. "Synchronous telegraphy." Muirhead & Co., Ltd., E. S. Heurtley, and J. V. Foll. May 12th, 1925. (255,979.)

12,577. "Dynamo-electric machines." British Thomson-Houston Co., Ltd., and A. A. Pollock. May 14th, 1925. (255,981.)

12,623. "Junction boxes and the like for electrical wiring systems." Fuller's United Electric Works, Ltd., and A. P. Welch. May 14th, 1925. (255,982.)

12,783. "Thermionic valves." General Electric Co., Ltd., and M. Thompson. May 15th, 1925. (255,983.)

12,853. "Dynamo-electric machines." British Thomson-Houston Co., Ltd., and H. Dreghorn. May 16th, 1925. (255,984.)

13,022. "Electrically-operated driving mechanism for spinning, doubling, twisting, and like machines." A. Stell and J. Stell. May 19th, 1925. (255,986.)

13,058. "Protective devices for high-frequency electric signalling systems and the like." F. W. Le Tall (Westinghouse Electric and Manufacturing Co.) May 19th, 1925. (255,987.)

13,875. "Blow-out for electric circuit breakers." English Electric Co., Ltd., and R. A. R. Bolton. May 27th, 1925. (Cognate application, 14,970/25.) (255,992.)

13,876. "Blow-out for electric circuit breakers." English Electric Co., Ltd., and R. A. R. Bolton. May 27th, 1925. (255,993.)

14,553. "Electrical signalling and controlling systems." Metropolitan-Vickers Electrical Co., Ltd. June 6th, 1924. (235,201.)

14,838. "Telephone installations." E. A. Driscoll. June 8th, 1925. (256,002.)

14,864. "Electrical heaters." E. A. Martin. June 8th, 1925. (256,003.)

15,470. "Apparatus for intermittently interrupting electric circuits." J. Bell & Croyden, Ltd., and W. R. Gray. June 15th, 1925. (256,009.)

15,994. "Jointing sleeves or ferrules for electric cables." Callender's Cable and Construction Co., Ltd., and A. E. Wilson. June 20th, 1925. (256,013.)

16,645. "Step-by-step switching apparatus for telephone systems." Coventry Automatic Telephones, Ltd., and C. C. Puckette. June 29th, 1925. (256,022.)

17,211. "Low-capacity inductance coils." E. & W. G. Makinson, Ltd., and J. K. Bartlett. July 4th, 1925. (256,028.)

17,371. "Electric switches for wireless receiving sets." W. Higgs. July 7th, 1925. (Cognate application 24,985/25.) (Patent of addition not granted.) (256,029.)

17,723. "Electrical measuring instruments." J. W. Record. July 10th, 1925. (256,032.)

17,813. "Combined electrical generators and internal-combustion engines." Douglas Motors, Ltd., and C. G. Pullin. July 11th, 1925. (256,034.)

18,995. "Dynamo-electric machines." British Lighting & Ignition Co., Ltd., and J. C. Hutton. July 25th, 1925. (256,045.)

19,267. "Shades for electric and other lights." E. C. R. Burrell. July 29th, 1925. (256,048.)

20,054. "Magneto-electric machines." J. E. Perisset. August 10th, 1925. (256,054.)

21,186. "Switch for electrical fuel-feeding apparatus." Dr. A. Nagel. August 26th, 1924. (239,202.)

21,214. "Combination sound-record containers and radio and gramophone amplifiers." Pooley Co. April 22nd, 1925. (251,228.)

21,852. "Electron-discharge apparatus." British Thomson-Houston Co., Ltd. September 2nd, 1924. (Addition to 170,546.) (239,511.)

22,407. "Automatic electromagnetically-controlled switch in the form of a screw plug." Dr. F. Von Glasser. October 2nd, 1924. (240,809.)

22,691. "Locking device for electric light fittings." F. A. Rees. September 11th, 1925. (256,074.)

22,781. "Low-frequency transformers for use particularly with receiving apparatus for wireless telephony." A. F. Godden and P. T. Bradley. September 12th, 1925. (256,075.)

23,721. "Electric discharge tubes." H. Wade (Naamlooze Vennootschap Philips Gloeilampenfabrieken). September 23rd, 1925. (256,077.)

24,669. "Electric distribution fuseboards." E. W. Moss (McClary Manufacturing Co.). October 3rd, 1925. (256,084.)

28,837. "Sound-controlled electric discharge lamp." De Forest Phonofilms, Ltd. January 10th, 1925. (245,740.)

31,231. "Electric meters." Brown Instrument Co. December 17th, 1924. (244,761.)

31,914. "Electric vacuum cleaners." Siemens-Schuckerwerke Ges. December 18th, 1924. (244,795.)

32,201. "Steam-driven electric generating plants, comprising arrangements for preheating feed water." Akt.-Ges. Brown, Boveri & Cie. March 24th, 1925. (249,817.)

32,345. "Automatic reclosing circuit-breaker systems." Igranic Electric Co., Ltd. (Cutler Hammer Manufacturing Co.). December 22nd, 1925. (256,117.)

32,460. "Manufacture of oxide cathodes for discharge tubes." Naamlooze Vennootschap Philips' Gloeilampenfabricken. December 27th, 1924. (245,147.)

1926.

918. "Electro-magnetic devices suitable for phonograph and the like recording and reproducing." Marconi's Wireless Telegraph Co., Ltd. (A. N. Goldsmith). January 12th, 1926. (Convention date not granted.) (246,163.)

3,359. "Means for regulating the speed of revolution of electrically driven ring spinning or doubling frames." Akt.-Ges. Brown, Boveri & Cie. February 6th, 1925. (247,208.)

5,079. "Meters for alternating current." Siemens-Schuckertwerke Ges. February 27th, 1925. (Addition to 231,167.) (248,370.)

5,699. "Vapour electric rectifiers and the like." British Thomson-Houston Co., Ltd. February 28th, 1925. (248,396.)